COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN No. 111.

SMALL FRUITS,

THEIR ORIGIN, CULTURE AND MARKETING.

BY

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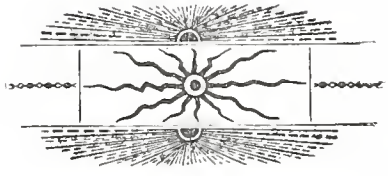
PUBLISHED BY DIRECTION OF THE SECRETARY.

1903.

WM. STANLEY RAY,
STATE PRINTER OF PENNSYLVANIA.
1903.



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PREFACE.

Harrisburg, Pa., March 23, 1903.

The following Bulletin No. 111, will be found to be one in which all the members of the household on the farm will be more or less interested. Every farmer takes some interest in raising, at least, enough of the orchard fruits to supply the family; but it is to be regretted that on many farms in the State of Pennsylvania, no attention is given to small fruit culture, except the limited supply raised in the small farm garden. This bulletin is issued by the Department in the hope that it may be the means, not only of inducing farmers to largely increase their home supply of the delicious products of the fruit garden, but in the additional hope that some of our people may be induced to take up the production of small fruits as a means of adding to the income upon the farm and assisting to supply the demand which our rapidly increasing population is creating for a most desirable and wholesome article of food.

The author, Prof. George C. Butz, needs no introduction to the fruit growers of Pennsylvania. His name appearing upon the title page as the author of this little work will commend it to all who know him.

N. B. CRITCHFIELD,
Secretary of Agriculture.

LETTER OF TRANSMITTAL.

State College, Pa., March 16, 1903.

Hon. N. B. Critchfield, *Secretary of Agriculture:*

Sir: I have the honor to transmit herewith a brief presentation of the modern small fruits and the most approved methods of their cultivation from the commercial standpoint. This branch of fruit cultnre has developed immense proportions in recent years, and Pennsylvania is one of the largest producers among the States of the Nation. The last censns report shows the crop of 1899 to have been valued at one and a quarter million dollars in Pennsylvania. Nearly all the fruits treated in this bulletin have been cultivated in the grounds of the Pennsylvania State College Agricultural Experiment Station, and the recommendations are based mainly upon the experience gained at this place.

The novelties among small fruits are included here, not to recommend them to frnit culturists, but to guard them against the extensive planting of them without due trial.

Very respectfully,

GEO. C. BUTZ.

SMALL FRUITS.

BY PROF. GEO. C. BUTZ, *State College, Pa.*

The cultivation of small fruits conducted upon a commercial scale is no small business for a bright, intelligent man to engage in. If a sufficient market is within reach, ten to twenty acres planted to small fruits will give employment to one-half as many employes and net a magnificent profit to the proprietor. It is seldom that the capacity of a community to consume fine cultivated berries is thoroughly tested because the supply that reaches the markets is speedily dispersed. The successful growers of small fruits usually estimate their profits at from $100 to $300 per acre, over and above all expenses. It is possible in favorable seasons to clear as much as $500 per acre in strawberries. The natural course for the prospective fruit grower is to begin with the small fruits, because the labor is light, the investment is small, and the returns are prompt and certain.

Insects and fungous diseases annoy the strawberry less than any other fruit. Frosts never do worse than take half a crop and seldom take a tenth under proper care and management.

In Pennsylvania the strawberry growers are inclined to fear the competition of southern fruit that is now shipped north in the early season. Pennsylvania berries, when properly grown, need not give way to the southern berry, for the former is the superior fruit in several particulars. It is larger, more highly colored, has better flavor and substance and is always fresher. The strawberry delights in the cooler climate of the north, and produces a finer fruit in Minnesota than it does in Florida.

The fruits now being cultivated and marketed under the general term of "small fruits" are, in the order of their commercial importance, as follows: Strawberry, raspberry, blackberry, currant, gooseberry, cranberry and huckleberry. In connection with raspberries and blackberries, are grown dewberries and such novelties as the loganberry, wineberry, strawberry-raspberry, etc. Other small fruits that have been given a trial in Pennsylvania are the

goumi, Buffalo berry and Juneberry. All of these are given a fair hearing in this bulletin.

Small fruit culture has assumed great proportions in recent years. Careful statistics for the United States have not been available until the publication of the census report for 1900. Former reports simply included the receipts from sales of small fruits with the sales of garden produce. The last report shows the total acreage in the United States to be 304,029, and the total value of the crop of 1899 to be $250,308.77, or an average of $82.33 per acre. Pennsylvania stands seventh in the list of States showing the largest valuation in small fruits, her share of the total being $1,268,827. The number of farms in Pennsylvania reporting yields of strawberries for 1899 was 25,682, yielding 70,179,430 quarts. In the production of raspberries, Pennsylvania stands fourth in point of yield, reporting 5,360,530 quarts. In blackberries, this State ranks eleventh, with a yield of 1,995,070 quarts. In currants her rank is seventh, with 1,031,870 quarts. A large acreage in small fruits is encouraged greatly by the existence of canning factories in a locality, and since there are but few such establishments in this State, it is clear that the extensive culture of these fruits is fostered by magnificent markets for the immediate consumption of the fresh berries. Canning factories are now being erected in several good agricultural sections of Pennsylvania, and no doubt they will encourage the extension of our acreage in small fruits.

The production of small fruits by counties in this State is shown in detail in the following statistics quoted from the report of the twelfth census. Allegheny county stands at the head. The soil in that region is well adapted to small fruits and the markets are unexcelled. Pittsburg, Allegheny and all the smaller manufacturing towns are great consumers of fruits. Erie county is also prominent in the growing of small fruits, having a recent stimulus in the erection of large canning factories. York and Lancaster counties have long enjoyed a reputation for large and excellent crops of small fruits, especially strawberries, and many good varieties of berries have originated in their gardens. Philadelphia markets are the occasion of large acreage in small fruits in Chester, Montgomery and other neighboring counties. Where mining operations are active, immense quantities of small fruits can be sold, and for such reasons their production is large in Lackawanna, Lehigh, Luzerne, Northampton, Schuylkill, Mercer, Washington and Westmoreland counties.

Total Value and Acreage of Specified Kinds of Small Fruits in 1899, by Counties.

Counties.	Total value of small fruits.	Strawberries.		Raspberries and Loganberries.		Blackberries and Dewberries.		Currants.		Gooseberries.		Unclassified Small Fruits.	
		Acres.	Quarts.	Acres.	Quarts.	Acres.	Quarts.	Acres.	Quarts.	Acres.	Quarts.	Acres.	Quarts.
The State,	$1,268,827	5,667	10,179,430	3,938	5,360,530	1,383	1,995,070	716	1,031,870	267	366,930	300	326,730
Adams,	6,407	23	31,230	25	30,960	27	33,290	1	1,330	1	630	8	8,040
Allegheny,	148,562	418	853,170	519	635,530	104	143,200	95	190,070	48	90,000	11	15,860
Armstrong,	12,234	40	66,710	79	80,920	15	17,080	3	3,630	2	2,220	7	6,600
Beaver,	46,406	107	275,200	151	201,500	137	264,410	17	36,450	18	27,490	5	7,220
Bedford,	4,491	14	12,600	16	20,030	32	42,250	4	5,430	(1)	180	2	2,190
Berks,	56,622	321	531,200	117	191,450	33	53,420	120	145,050	16	24,170	8	4,390
Blair,	17,161	43	67,970	62	90,550	22	22,950	33	34,670	2	1,890	6	7,260
Bradford,	24,737	108	162,790	66	88,490	15	22,750	7	10,180	2	2,320	7	8,370
Bucks,	24,384	119	211,410	29	47,690	24	40,700	20	35,510	8	9,570	3	2,740
Butler,	14,768	36	67,480	70	115,190	18	31,730	5	6,450	4	5,210	(1)	40
Cambria,	11,052	26	45,810	45	67,240	8	9,920	6	8,710	2	3,080	(1)	100
Cameron,	1,100	7	12,180	1	920	1	490	(1)	390	(1)	180	.....	.....
Carbon,	5,822	17	28,150	8	13,580	9	15,160	4	4,140	1	650	6	6,780
Centre,	6,043	25	49,640	12	17,990	6	9,580	2	4,080	1	560	1	1,060
Chester,	37,166	174	347,650	34	56,180	26	35,300	12	17,890	10	11,880	5	6,810
Clarion,	6,790	12	22,480	35	54,200	10	17,320	1	1,650	1	490	2	2,610
Clearfield,	5,743	25	39,420	12	17,370	4	4,910	3	4,860	2	1,970	5	6,420
Clinton,	4,277	18	23,700	12	17,920	2	2,830	2	2,340	(1)	290	1	560
Columbia,	12,983	44	78,010	48	66,620	12	20,640	5	4,630	(1)	160	2	1,090
Crawford,	25,767	140	299,720	78	110,380	16	25,890	5	6,490	1	1,460	1	550
Cumberland,	12,897	74	162,670	27	49,840	9	14,190	3	3,700	1	890	(1)	40
Dauphin,	14,261	50	99,760	37	40,530	21	23,340	20	26,750	3	3,220	13	8,560
Delaware,	10,836	50	90,380	15	16,080	7	9,420	12	19,420	6	7,670	1	910
Elk,	1,868	11	24,700	2	1,890	5	6,080	(1)	280	(1)	180	1	740
Erie,	60,623	280	665,730	247	361,800	90	131,320	48	51,480	15	20,530	7	7,280
Fayette,	24,751	71	149,740	114	113,000	49	65,460	5	6,410	4	3,540	3	2,500

Total Value and Acreage of Specified Kinds of Small Fruits in 1899, by Counties—Continued.

Counties.	Total value of small fruits.	Strawberries.		Raspberries and Loganberries.		Blackberries and Dewberries.		Currants.		Gooseberries.		Unclassified Small Fruits.	
		Acres.	Quarts.	Acres.	Quarts.	Acres.	Quarts.	Acres.	Quarts.	Acres.	Quarts.	Acres.	Quarts.
Forest,	445	3	3,660	1	1,440	(1)	20	(1)	390	(1)	140	1	900
Franklin,	13,961	75	96,390	25	39,250	32	55,360	2	2,530	1	950	15	19,510
Fulton,	1,858	9	11,470	4	4,880	7	8,140	2	2,150	(1)	310	11	5,570
Greene,	17,176	18	24,850	80	127,170	20	29,810	1	570	1	400	1	1,210
Huntingdon,	8,789	35	50,740	45	59,480	10	8,380	2	1,330	(1)	140	10	14,250
Indiana,	7,516	25	42,210	18	29,670	21	17,910	2	1,650	2	1,000	1	1,610
Jefferson,	8,439	35	49,430	25	43,860	11	18,890	2	2,650	3	3,890	3	3,150
Juniata,	5,075	22	23,940	71	68,470	6	8,070	1	810	(1)	20	1	1,980
Lackawanna,	22,425	100	158,110	80	102,310	16	23,360	3	3,740	(1)	200	8	4,910
Lancaster,	71,278	365	635,570	105	159,990	98	145,430	55	83,210	20	26,680	35	43,460
Lawrence,	21,009	95	139,370	99	135,240	43	50,060	3	3,910	4	4,930	(1)	210
Lebanon,	13,435	95	133,350	32	42,760	8	12,520	13	20,130	2	2,610	1	560
Lehigh,	30,831	180	264,550	65	100,880	13	18,770	18	29,560	9	11,060	4	5,210
Luzerne,	26,437	116	230,520	141	129,840	28	28,240	25	42,240	3	3,570	10	10,400
Lycoming,	15,699	76	183,340	40	65,250	13	14,790	4	5,020	1	1,570	7	7,240
McKean,	1,164	8	12,330	2	1,400	(1)	200	1	400	(1)	110	(1)	70
Mercer,	33,257	170	343,510	129	187,310	42	55,960	6	6,890	4	4,040	1	910
Mifflin,	4,480	24	40,450	16	18,900	4	5,780	1	960	(1)	140	14	19,760
Monroe,	8,727	27	45,030	17	27,480	15	23,010	9	9,910	3	3,140	14	16,240
Montgomery,	34,534	133	267,900	21	34,450	16	26,520	20	30,180	19	27,780	16	17,170
Montour,	3,695	17	34,170	13	19,900	4	3,410	1	1,040	(1)	50	(1)	240
Northampton,	37,324	180	362,640	62	100,340	16	24,370	17	26,170	9	10,210	4	3,680
Northumberland,	18,600	82	165,410	62	109,610	12	16,290	16	26,890	1	530	1	700
Perry,	3,693	20	34,030	13	18,730	2	2,950	1	810	(1)	160	.....	.....
Philadelphia,	3,136	14	28,330	1	1,790	(1)	130	3	4,420	1	980	7	9,500
Pike,	2,556	14	23,010	2	3,650	4	6,050	1	1,130	(1)	190	1	1,950
Potter,	2,381	10	18,510	6	5,720	(1)	230	1	1,600	1	1,380	.....	.....
Schuylkill,	20,278	150	223,820	30	26,880	13	14,490	15	22,500	1	1,860	(1)	270
Snyder,	16,712	122	183,820	80	117,480	13	17,180	2	3,040	(1)	220	(1)	100

Somerset, ...	8,834	25	37,070	42	56,860	13	17,740	6	8,110	1	1,590	2	2,860
Sullivan, ...	440	1	850	2	2,680	(1)	200	(1)	390	(1)	100	2	1,060
Susquehanna, ...	21,118	130	241,000	60	93,110	10	14,530	3	3,520	1	410	5	6,010
Tioga, ...	7,869	24	40,680	36	55,140	4	3,120	8	11,140	2	2,880	(1)	40
Union, ...	5,639	31	46,270	19	27,520	4	5,090	2	2,310	1	640	(1)	200
Venango, ...	12,401	63	98,060	54	76,340	16	26,910	3	3,050	1	610	5	6,440
Warren, ...	7,100	33	47,060	31	46,530	2	2,540	3	2,220	1	630	(1)	110
Washington, ...	33,203	124	200,490	163	166,820	65	85,220	10	9,450	11	9,000	2	1,190
Wayne, ...	8,338	49	66,050	16	25,880	3	3,130	3	3,890	11	14,460	3	1,860
Westmoreland, ...	37,111	147	236,500	142	185,220	46	52,770	9	9,410	3	3,990	3	4,060
Wyoming, ...	15,114	61	114,640	78	109,410	10	14,620	1	1,600	(1)	220	(1)	130
York, ...	58,999	506	835,800	149	226,100	41	69,250	8	14,960	2	3,710	7	3,350

STRAWBERRY.

The most delightful occupation for any one, man or woman, who enjoys working the ground and handling fruits is the growing of strawberries. The work is all light, easy and pleasant; at the same time it is highly remunerative. The returns come quickly and encourage the proprietor to plant more extensively. The farmer who grows wheat is proud of his success if he harvests 40 bushels of the grain per acre. A bushel once represented a dollar, and if the price is ever reached again he makes $40 per acre; but the strawberry grower with an acre or more in this fruit harvests at least 100 bushels to the acre, and at the lowest wholesale price receives the prompt return of $1.60 per bushel. If, however, he has performed his work well, and no adversity has befallen his crop he markets 500 bushels of strawberries from an acre and receives for them $1,000. These figures are by no means the highest that have been realized in strawberry culture. The most extensive strawberry grower in the world is W. F. Allen, at Salisbury, Md., who carries about 200 acres planted to this fruit.

Origin of Cultivated Varieties.—All the principal varieties of strawberries in American gardens are descendants of the species *Fragaria Chiloensis* which is native to the Pacific slope of North and South America. Until Prof. L. H. Bailey* demonstrated this fact, all horticultural writers on the strawberry, referred our garden varieties to the species of our eastern States, *Fragaria Virginiana.* This species has given but few varieties and they were promptly dropped from cultivation. In Europe the varieties of strawberries under cultivation are from the Alpine (*F. Vesca*) and Hautbois (*F. moschata*) species; occasionally some of these varieties are brought to America, but they never win favor. The type of *F. Vesca* is well known to Pennsylvanians by our American representative of this species, named *F. Americana* by Britton, but regarded by Bailey as a form of *F. Vesca.* The Everbearing strawberry recently advertised in catalogues is one of several French varieties of the Alpine strawberry, known in Europe as *Fraisier des quatre saisons.* These may have red or white berries and may or may not produce runners. The quality of the berries is disappointing to American taste and the bearing of fruit after the first crop is spasmodic and uncertain.

Soils.

In is a remarkable fact that the strawberry may be grown successfully in a great variety of soils; sandy loams, clay loams and shale soils have all been used with good results, providing they are

*Survival of the Unlike, 1897, p. 400.

fertile, well drained and contain enough humus to retain large amounts of moisture. Deep soils are more likely to furnish these conditions than shallow soils, and other things being equal, the clay loams with proper handling will be cooler and retain moisture better than sandy and shaley soils. If a variety of soils are at command it is preferable to plant on several of them at the same time, and thus by suiting the variety to the soil, the length of the fruiting season may be greatly extended. The nature of the soil and its exposure has much to do with the time of ripening of the fruit. Early varieties planted on a sandy soil with southeastern exposure and late varieties planted on a clay soil with a northwestern exposure and covered with a good mulch, so long as conditions will permit, will easily extend the season of ripe fruit to two months instead of five or six weeks as ordinarily experienced.

Land that has been lying in sod until it is infested with white grubs and other insects, should not be directly used for strawberries. The best preparation of land to be used for this fruit, or any other fruit, is to crop it a year or two with a vegetable that requires frequent cultivation and hoeing during the growing season, and for which liberal manuring is essential. It should be particularly free from weeds of the perennial kinds, like dock, plantain, Canada thistle, milk-weed, etc. Red clover plants are also undesirable weeds in the strawberry patch.

Land which is not very fertile is often used for this fruit by employing fertilizers during the progress of the crop. In such cases the plant food should consist mainly of potash and phosphoric acid, for an excess of nitrogen after the plants are established is likely to make large sappy plants and diminish the crop of fruit. In all cases it is better to enrich strawberry ground with a liberal application of barnyard manure on the preceeding crop, or when preparing the soil for berries apply twenty two-horse loads of manure to the acre and plow it down in the fall, or early spring. Before the plants are set the surface should be harrowed to thoroughly pulverize the soil. With such preparation a good stand of plants will be made in their first season and a fine crop of berries may be expected in the second season.

The largest and most successful plantations of strawberries are upon rich bottom lands, near large streams, or in lake regions, where fertility ranks high and the surface of the land is uncomfortably near a dead level. The danger in this latter condition is in not having good drainage. In selecting a piece of rich land, therefore, it is important to select good underdrainage, and it is all the better if surface drainage is possible upon it to carry off the superfluous water. An abundant supply of water is essential for a fine

crop of berries but it must be administered as moisture and not as a mulch.

On the moist hillsides of York and Cumberland counties many highly colored strawberries are grown by merely grubbing the surface of newly cleared hills and setting the plants. There are many inconveniences connected with such culture, but the available potash and phosphoric acid in these soils certainly produce fine color and excellent quality in the fruit.

Successive plantings of strawberries may be made upon the same land if due regard is given to fertilization, but it is always much better to practice a rotation of crops, following the berries with a vegetable crop, as cabbage, canteloupes or corn. One season, or at least a part of a season, should be devoted to a crop for green manuring, as crimson clover, cowpea, vetches or some other leguminous plant.

Fertilizers.

In these days of the use of commercial fertilizers, the question is often asked, "What is the best fertilizer for this or that crop?" This question cannot be answered in the nature of a formula by the most learned chemist or in the case of strawberries by the most experienced and successful grower. A chemical analysis of the soil and one of the crop are of but slight assistance in reaching an answer to the question, and yet such analyses are important in determining the principles underlying soil improvement. When the question concerns a particular soil and crop, then its proper answer can be secured only by the trial of approved fertilizers in different proportions. It is customary for strawberry growers to depend largely upon barnyard manure, applying from 20-60 two-horse loads to the acre when the land is prepared and many of them use a strawy manure for a winter mulch. Such a fertilizer, being essentially nitrogenous, tends to produce thrifty plants that are more remarkable for their vigor than their crop of fruit. On soils that are naturally well supplied with potash and phosphoric acid the evil effects of heavy applications of manure would not be experienced.

The analysis of the mineral constituents of the fruit of the strawberry shows how important are the two constituents, potash and phosphoric acid, in its development.

Mineral constituents of the strawberry.

Potash,	49.24
Phosphoric acid,	18.50
Lime,	13.47
Magnesia,	8.12
Silicic acid,	5.66
Soda,	3.23
Iron,	1.74

The above figures represent the per cent. of the several constituents in the ash of the fruit, the nitrogen, which, of course, is an important plant food, does not appear in this analysis because it is not a mineral element. It has been driven off in the destruction of organic compounds by burning.

It is clear from this analysis why such marked results are observed in the strawberry when potash and phosphoric acid fertilizers have been used upon the crop. Experience upon a variety of soils warrants the use of a fertilizer consisting of three per cent. nitrogen, seven per cent. available phosphoric acid and nine per cent. potash, using 25 to 50 pounds of nitrogen, 55-100 pounds of phosphoric acid and 75-150 pounds of potash to the acre. To obtain this, Dr. L. L. Van Slyke* recommends the use of—

50-100 pounds nitrate of soda,
100-200 pounds dried blood,
100-200 pounds cotton seed meal,
375-750 pounds dissolved rock,
150-300 pounds muriate of potash,

and makes the following suggestions: "Apply about 800 pounds of this mixture per acre before the plants are set. The next spring, preceeding the first crop, make the same application. It may also be found good practice to apply top-dressing of nitrate of soda at the rate of 100 pounds an acre after the plants have blossomed."

Clay soils, as a rule, are better supplied with potash than sandy soils, hence a lighter application of that plant food will give satisfactory results on clay soils. On sandy soils the soluble plant foods are leached downward beyond the reach of strawberry roots, therefore an annual application of fertilizers is highly profitable. Owing to the many conditions of soils, it is apparent, from what has been said, that the question of fertilizers for strawberries is best solved by the trial of plant foods upon the crop where it is to be grown. It may be that barnyard manure alone will give as good results as could be obtained by the use of any other fertilizer. Notwithstanding the great amount of potash in the fruit, a report from the Mississippi Experiment Station,† states that "In most of the clay soils of Mississippi, there is sufficient potash to supply the demands of the so-called potash plants, the strawberry being one of the number included in the list." This report recommends the use of 400 pounds of acid phosphate and 200 pounds of cottonseed meal per

*Bul. 55, Dept. Agr., Penna.
†Bul. 75, Miss. Exp. Sta., 1902.

acre on such soils, thus applying only the slight amount of potash that is contained in the cottonseed meal.

Commenting upon the results of fertilizer experiments conducted upon the strawberry farms about Oswego, N. Y., Prof. L. H. Bailey* says: "Through the three years' tests the benefit of using both potash and phosphoric acid may readily be seen as also the fact that in most cases, when commercial nitrogen was used, the returns in fruit failed to pay for the outlay. The benefits derived from the use of potash or phosphoric acid are not only the increase in yield, but these materials had a tendency to harden the fruit, and to give them a richer color. In every case where these have been used, the grower reports firmer and better colored berries, which means better shippers and better sellers.

"It will be seen by a study of Experiment I, that when an increase from 200 to 400 pounds of wood ashes was made, at a cost of not exceeding one dollar, the yield was greater by 640 quarts (per acre) than when only 200 pounds had been used. This yield, figured at five cents per quart, would mean a gain of $32.20. In the same table, the increase from 300 to 900 pounds of muriate of potash was money well invested. The first increase from 300 to 600 pounds, at a cost of $6.20 shows a gain in yield of 792 quarts with a money gain at five cents a quart of $36.90. Again increasing the amount of potash 300 pounds, making 900 pounds per acre at an increase in cost of but $12.50, the gain in fruit is shown to be 1,782 quarts, and the money gain $89.10.

"In Experiment 2, the result of increasing from 500 to 1,000 pounds of dissolved rock, at a cost of not over ten dollars, was a cash gain of $54.65. Nitrate of soda used alone gave a yield of 800 quarts per acre less than when the same weight of muriate of potash was used with it."

These experiments were made upon ideal strawberry soil, a gravelly loam with perfect natural drainage and an abundance of humus. The yields of fruit per acre were estimated at from 5,891 to 8,383 quarts. In the course of these experiments a remarkably large yield of fruit was obtained from a plot of rich bottom land, using 70 pounds dissolved rock on one-tenth of an acre. The yield estimated for the acre was 20,066 quarts.

Setting the Plants.

The plants may be set out in the fall or spring. Some planters prefer the fall, others prefer the spring and still others will plant at either time. Fall planting meets with success if the work is done in August or early September rather than at a later date, but

*Bul. 189, Cornell Exp. Sta., 1901.

of course it is also dependent upon rains to cool the ground and supply moisture to the roots of the plants. This early fall planting in Pennsylvania makes it possible for the plants to become well rooted in their new conditions before winter weather can interfere, and consequently the heaving out of plants by frosts is but slight. Spring planting is always safest.

For extensive garden and field culture nothing but "layer plants," such as are naturally produced by the plants are used, but for small home gardens, many nurserymen grow what are termed "pot grown" plants, by sinking two and one-half or three inch pots in the ground under a newly formed runner or stolen early in July, thus catching the entire make of roots in the ball of earth contained in the pot. Such plants may be transplanted to the garden in August or September without loss of vigor and develop strength enough to bear a fair crop of fruit the following June. Layer plants of course are not expected to bear fruit the first season after planting; in fact it is good practice to pinch out the first crop of blossoms to develop strong plants for the second season.

Pot-grown plants are intended for private gardens and are more expensive than layer plants. The price of the former is $4.00 per hundred plants of a variety which could be purchased at 40 cents per hundred of the latter.

Spring planting calls for an early preparation of the soil. As soon as the ground may be worked the manuring, plowing and harrowing should be attended to, and the position of the rows marked by light furrows.

The best layer plants are those taken from plants which have never borne fruit, that is from plants set the previous season, such layers are always more vigorous than those taken from older plantations but it is not always possible to obtain such plants for the first setting. If young plants are taken from older plantations, care should be exercised to select only the runners formed the previous season. These plants will have none but light colored roots while older plants will have black and dead roots mingled with the healthy roots, all such should be discarded.

An important matter in handling strawberry plants is to keep the roots moist. They should never be exposed to sunshine, or dry winds. If they cannot be promptly carried to the new ground and set out, the roots should be covered with wet moss or a damp cloth. If it becomes necessary to plant with little prospect of rain it is helpful to puddle the roots by dipping them into a tub of very soft mud. This will serve to keep the air from the roots until the plants are set. Roots that are more than three or four inches long may be cut to that length so that the planting may proceed more rapidly.

Devices have been made for the purpose of taking up young plants with the soil in which they grow to transfer them in this manner to their new places. The most successful consists of a cylindrical bucket of galvanized iron having no bottom. This is forced into the ground about the plant to be taken, and as it is drawn out the plant and soil come with it. A similar piece is used to make a hole in the new ground and the plant is dropped into it. The idea is an excellent one, but cannot often be put into practice. The expense and other circumstances make it impracticable.

Experience varies in regard to the distance between plants, formerly it was commonly the practice to plant in rows three and one-half or four feet apart, with fifteen inches between plants in the row. Then the production of runners was encouraged until a solid matted row eighteen inches wide was formed. A width of two feet even has been permitted by some growers, but in all such cases the plants in the interior of the mat produce small berries, and their productiveness is limited to about two weeks, while the plants along the edges produce large berries for a longer period. The outcome of this observation is to make very narrow matted rows and more of them by planting in rows 30-36 inches apart with the plants 18-20 inches apart in the row.

Whatever can be done to expedite the work of setting out plants will prove advantageous; a boy dropping the plants from a basket just ahead of the setter is a good plan, and if the weather is bright and the ground dry, each plant should be watered promptly. The setter is responsible for the proper setting of the plants. The roots should be spread in the hole, the ground made firm about the roots, and the crown or heart of the plant should rest just above the surface of the ground when it is settled by water.

Cultivation.

During the first season, after setting the plants, every advantage should be given them to develop strong growth, for a good stand of plants is always a forerunner of a large crop of fruit. Because no fruit is picked the year should not be an excuse for careless treatment. Weeds should never be allowed to get beyond their third or fourth leaf, and frequent stirring of the soil with a suitable cultivator will make the cheapest and best summer mulch that could be secured for berry ground. There is no better implement for this than the Planet Junior Cultivator. Such cultivation will begin soon after spring plants are set and continue into September. In case a fall planting has been made and the plants give promise of a fair crop, cultivation must be deferred until the fruit has been harvested. It is often a question whether the gain in such a crop

would warrant the loss sustained by the plants in the maturing of it. If the cultivator covers the hearts of the plants with soil, this should be removed at once. It can be done by following the cultivator with a hoe to perfect the work and at the same time cut out weeds standing in the row.

Many of the spring set plants and even more of the fall set plants will produce some flowers the first season, and if it is not intended to pick the fruit, the blossoms could profitably be pinched out for the benefit of the plants. The same is true concerning the development of runners a little later. If "hill culture" is to be followed, the runners are cut away with the hoe as fast as they appear. Hill culture insures the largest berries and, with many varieties, the largest crop also. The "matted row" culture is most commonly practiced by the commercial grower because of the heavier yield per acre. If the matted row system is chosen it is well to encourage the rooting of the first runners by bedding them in, that is, covering the runner with ground near the plant where it is intended to establish itself, and cutting off the tip that would form a second plant. As stated before, wide matted rows should be avoided, one foot wide is best, and if the variety planted is disposed to make runners freely they should be thinned out to avoid the dense crowding of plants which always results in small berries.

The ideal stand of plants is that in which the plants at the close of the first season are not closer than four or five inches, and are uniformly distributed over the twelve inch strip of ground devoted to each row.

When runners have been permitted to form excessively, they may be thinned out in the fall to use in planting new fields, or for sale. In the latter case they are usually tied in bunches of twenty-five and "heeled in" in trenches of mellow soil where they may be easily obtained when filling orders. If they are not called for until spring a heavy mulch of leaves or straw will furnish ample protection for the winter.

Mulching.

It is a very common practice to mulch strawberries to protect the plants during the winter, prevent heaving and avoid the freezing of buds in early spring. Sometimes the mulch is allowed to remain on the plants late in the spring to retard the blossoming. Flowers may be retarded from one to two weeks in this way. As a winter protection, a mulch is more important where there is not continuous covering of snow, for winter killing is occasioned not by low temperatures, but by frequent exposure to a warm sun when the plants are in a frozen condition. A variety of materials may be used for

a mulch, whatever is most easily and cheaply obtained is to be preferred. A loose, strawy manure has long been used in practice because it imparts a fertilizer to the soil while it protects the plants and thus serves a double purpose. There is an objection to the use of manure, in the likelihood of its imparting clover or weed seeds to the soil. In regions near the sea coast, salt hay from the tide marshes is much used. Pine needles (called pine straw) are used in the south. Any grain straw that is partly rotted is excellent material. It is customary to put about two or three inches of material on the plants. The application is not made in this State until the ground is frozen sufficiently to bear the wagon or cart, that is early in December. If the material is abundant, the entire surface is covered, otherwise the plants only are covered. On the arrival of spring and the first signs of growth appear, the mulch is drawn from the plants to the space between the rows to hold moisture in the ground, prevent weed growth and keep the berries clean in times of rains. Some growers go to the expense of hauling the mulch off of the patch to cultivate once or twice before the berries begin to form and, in some cases, returning it to prevent the dirt splashing onto the fruit. If a few weeds appear among the plants in the spring they should be removed without disturbing the ground much. They may be broken off or cut off at the surface of the ground.

Treatment after Harvest.

Many experts prefer to keep a plantation of strawberries for only one crop of fruit, then plow the ground immediately after harvest to prepare the land for some other crop. This preference is based upon the belief that the first crop of fruit is the best crop and that it is cheaper to plant a new bed than to keep the weeds out of the old one. It is not always true that the first crop of fruit is the best. Careful observation, extending through several years in growing strawberries at the Pennsylvania Experiment Station, show that many varieties yield more abundantly in their second fruiting season than in the first, and the size and quality of the berries have not deteriorated. It is wise, therefore, for each grower to determine for himself by careful observation upon the varieties he grows, whether to take but one or two crops from a plantation before plowing it down.

It is often true that obnoxious weeds take hold of strawberry fields in spite of careful cultivation, and to such an extent that it is economy to plow down and plant annually.

The beginner in strawberry culture will gain valuable experience by planning to keep his first bed for two crops of fruit. If the plants

occupy the ground three years and produce two good crops his income per acre per year will be greater than if the ground is occupied two years for one crop only.

Cultivation during the second season cannot begin until the crop of fruit is removed. Much tramping between the rows in all kinds of weather to gather the berries has detroyed the spongy condition of the soil, therefore, deep cultivation is called for. If the matted row is from twelve to eighteen inches wide and densely set with plants the half of them should be cut out. The way this is accomplished in the extensive plantations of the southwest is ably described by A. B. McKay* as follows:

"With a sharp one-horse turning plow, bar the rows off, leaving a narrow strip covered with plants. With nicely matted rows we may plow away one-half to two-thirds of the plants, leaving only the younger and more desirable ones along one edge of the row. Follow immediately behind the turning plow and in the bottom of the turning plow furrows, a subsoil plow should be run as deeply as the strength of a strong mule or horse will permit. A one-horse Brinley turning plow, with the wing removed, and a sharp steel point tightly screwed on, makes an excellent subsoiler. In the absence of a subsoil plow, the bull tongue or scooter will answer. A fine tooth harrow, well weighted, is run once or twice over each middle to smooth down the soil between the rows. Hoe hands follow, cleaning weeds and grass from the drill, and cutting plants to the required stand, eight to ten inches apart in the row. If dry weather prevails, some earth should be worked back to the plants almost immediately after barring off and subsoiling. One trip on each side of the line of plants with a shovel plow will leave a nice little ridge of pulverized soil sifted between and to each side of the plants. In this condition, unless very dry, work may be suspended without injuring the plants until the grass and other green rubbish covered in the middles have had time to die. The turning plow is then used to spread the middles, or work the soil back to the plants. Follow the turning plow with the subsoiler as directed after barring. We now have the soil deeply stirred and well broken throughout the entire space between the lines of plants. The sweep, the cultivator and the harrow used from this time forward, as directed for the first year's cultivation, will complete that of the second."

Varieties.

One of the first things a strawberry grower should understand about varieties is that some are perfect flowered, that is, there are both stamens and pistils in the flowers, and others are pistillate-flowered,

*Bul. 75, Mississippi Exp. Station, 1902.

that is, stamens are absent. The strawberry in its natural state is perfect flowered, but in cultivation through the development of new and highly improved varieties, the stamens become aborted and flowers with pistils only are the result. The absence of stamens is not necessarily a mark of superior quality, neither does it indicate anything definite concerning the size of fruit or the productiveness. It should be understood, however, that pistillate varieties planted alone cannot be expected to set much fruit because pollen from the stamens is essential to fruit production. It is customary in planting pistillate varieties to put in every third row a staminate or perfect-flowered variety to furnish pollen. For best results the flowering periods of the two varieties should coincide. On this point W. F. Allen, a prominent strawberry grower in Maryland, makes the following recommendations:

"WHAT TO PLANT WITH PISTILLATE VARIETIES.

Name of Pistillate Variety.	Varieties Suitable for Planting with Pistillate Varieties to Properly Pollenize Them.
Bubach (P),	Bismarck, Brandywine, Saunders or Tenn. Prolific.
Barton's Eclipse (P),	Saunders, Clyde or Tenn. Prolific.
Crescent (P),	Tubbs' Splendid or Senator Dunlap.
Haverland (P),	Tennessee Prolific, Saunders, New York or Nick Ohmer.
Kansas (P),	Brandywine, Aroma, Pride of Cumberland or Saunders.
Lyon (P),	Splendid or Senator Dunlap.
Marie (P),	Saunders or Brandywine.
Minute Man (P),	Brandywine, Saunders or Pride of Cumberland.
Sample (P),	Tenn. Prolific, Saunders, New York or Nick Ohmer.
Sutherland (P),	Clyde or Saunders.
Warfield (P),	Senator Dunlap or Splendid.

"Varieties named are not the only ones that may be used for pollenizing pistillate varieties but they are what I consider the most desirable for the varieties named. Glen Mary is a semi-staminate and while it is all right to plant alone, I do not advise its use to plant with pistillate varieties."

There are hundreds of varieties of strawberries, and many new ones introduced each year. The beginner should choose a few well tried varieties for his principal planting and experiment lightly with the new promising sorts. The character of the soil and the treatment given are prominent factors in choosing suitable varieties. Varieties with largest berries are not likely to be the most prolific. High quality in the fruit often corresponds with long vigor in plants, extremely early berries may result in a short crop. Facts like these make it impossible to arrange the list of varieties in order of excellence to fit various conditions.

The varieties generally planted in Pennsylvania are Brandywine, Bubach No. 5, Crescent, Gandy, Glen Mary, Haverland, Jessie, Parker Earle and Wakefield.

In the following table prepared from records made at the Pennsylvania Experiment Station, the planter will find considerable help in making a selection of varieties. The list includes nearly all that

would interest planters in Pennsylvania, both of standard and new varieties. The letter (P) after a name indicates that it is pistillate-flowered, all others are perfect-flowered. The column of dates indicating the time of first flower applies particularly to the region in Centre county where the observations were made. At other points in the State these dates would be too late or too early according to the location but they will serve to select varieties that should bloom about the same time. The columns of dates of first and last ripe fruits likewise may be found serviceable in selecting early, medium, and late varieties and in showing the length of the fruiting season. The dates of last ripe fruits are all a little later than the last profitable picking. The yields are such as were recorded in the season of 1901 which was very favorable to the crop. The comparative productiveness is indicated by the number of quarts picked during the season from thirty feet of matted row. The yield per acre may be estimated. In the last column of figures the vigor of the plants is expressed rating on the scale of ten; the greatest degree of vigor being expressed by ten.

For other characteristics of varieties, the reader is referred to nurserymen's catalogues which usually give faithful description of the berries and plants.

It may be remarked here that the white fruited varieties like Lennig's White and the French everbearing varieties like St. Joseph, Leon XIII and Belle de Meaux are to be regarded merely as curiosities by the commercial grower, and even the amateur will find little satisfaction in growing them.

Strawberries. Records at State College, Pa.

	First flower.	First ripe fruit.	Last ripe fruit.	Yield of 30 foot mat.	Vigor.
				Quarts.	
Adams Favorite (P),	May 8,	June 13,	July 17,	26	8
Banquet,	2,	11,	15,	16	6
Beebe,	8,	12,	10,	8	4
Bismarck,	23,	12,	9,	14	7
Brandywine,	9,	13,	18,	18	8
Bubach (P),	12,	8,	4,	16	9
Carrie (P),	8,	13,	18,	13	8
Clyde,	9,	7,	8,	17	9
Crescent (P),	6,	10,	10,	26	8
Crawford,	4,	10,	12,	27	8
Dayton,	6,	11,	8,	6	7
Ella,	1,	7,	1,	10	8
Enhance,	7,	13,	12,	25	8
E. P. Roe,	2,	11,	12,	22	8
Gandy,	18,	19,	18,	16	9
Glen Mary (P),	8,	8,	10,	28	10
Greenville (P),	6,	10,	10,	8	9
Harrison (P),	8,	12,	17,	28	8
Haverland (P),	7,	11,	10,	15	7
Hann (P),	19,	21,	19,	16	8
Jessie,	9,	11,	10,	13	7
Margaret,	7,	13,	12,	17	7
Marshall,	17,	12,	8,	22	9
Mary (P),	9,	13,	12,	17	9
Maximus,	18,	12,	10,	10	8
McKinley,	13,	13,	10,	15	7
Meek's Early,	6,	7,	2,	7	7
Miller,	13,	11,	8,	15	9
Mt. Joy,	7,	11,	16,	17	9
Nick Ohmer,	12,	14,	8,	14	7
Parker Earle,	7,	13,	16,	17	10
Rough Rider,	17,	15,	21,	20	8
Sample (P),	11,	12,	17,	25	10
Senator Dunlap,	12,	15,	18,	24	9
Shuster (P),	7,	11,	10,	20	7
Van Deman,	4,	10,	16,	29	7
Warfield (P),	7.	11,	16,	30	7
Wm. Belt.,	15,	12,	10,	18	7

Harvesting and Marketing.

A critical time in successful berry culture is when the fruit is ready for market. Ample provision must be made for the work, baskets and crates should be on hand, a good force of pickers engaged, and the market to be supplied carefully selected. Only clean, quart berry boxes should be used, and it is better not to recall them from the customers. A soiled and faded box will greatly reduce the market value of the fruit, and the finer the quality of the fruit the greater will be the reduction in value. Good substantial crates for carrying 32 or 60 quarts are commonly used both for hauling and shipping.

The pickers should be instructed to pick only ripe berries, taking none with green or white tips; all such mar the appearance of the

fruit. They should also be instructed to pick and throw aside all nubbins, overripe, and otherwise imperfect fruits, for these if left on the plants draw heavily on the strength of the vines at the expense of the younger fruits, and of course all such inferior fruit should have no place in the basket, not even in the bottom. The fruit should not be permitted to stand in the sun in the field, but should be promptly carried to a cool shade under cover, where each box is carefully topped by laying the berries on the surface all one way showing the side of the fruit. The calyx should always be left on the strawberry.

It is a good practice at the packing house or shed to turn the berries from the baskets used by the pickers in the field, into new baskets so that perfectly clean packages will go to market.

The best time of the day to pick strawberries is in the morning before they become warm, but they should not be picked if they are wet with dew or rain. Nevertheless every experienced grower knows he cannot always wait for the most perfect conditions.

The home market is the most profitable one to supply, for there the fruit reaches the consumer in the freshest condition and there is no expense of commission men to reduce the profits. It is not always possible to dispose of a large crop in a home market and it becomes necessary to deal with commission houses to dispose of surplus stock. Before a consignment is made the grower should visit the commission merchants, study their market, the class of goods they handle, and select the man he can trust to handle his goods. There should be mutual confidence established before any agreement to supply fruit is effected. When the proper merchant is found he should receive all the berries that can be sent to him.

Profits in Strawberries.

From the data given in the table on page 11 it may be estimated that the yields per acre will range from 3,000 to 15,000 quarts or from 90 to 360 bushels, even greater yields than these have been reported, but phenomenal crops cannot be considered in estimating profits. The very wide range of yields according to varieties grown side by side under the very same conditions, makes it impossible to figure profits with any degree of certainty, but we may observe that by a proper selection of varieties, with good culture and a careful and business like handling of the crop it is not impossible to net magnificent returns.

The expense connected with the growing and marketing an acre of strawberries varies under different conditions almost as much as the yields, hence any estimate that would be given could serve only

as a suggestion. In this State it is fair to figure on the following instance:

Interest and taxes on land, 2 years,	$12 00	
Preparation of soil,	4 00	
Plants, 10,000 at $3.00 per M.,	30 00	
Setting plants,	5 00	
Summer cultivation, hoeing, etc.,	20 00	
Mulch and mulching,	12 00	
Manure and fertilizer,	40 00	
Cost of picking and marketing 7,000 quarts,	100 00	
Total,	$223 00	
Gross receipts, 7,000 quarts at 8 cents,		$560 00
Deducting expense,		223 00
Net profit per acre,		$337 00

One grower reports upon his crop for 1902 that it was not as good as the crops of the two preceeding years. From a plantation of about two acres he marketed 220 crates of strawberries and realized $497.88.

Cost of picking,	$64 65
Commissions,	43 08
Loss and wear on crates and boxes,	9 00
Marketing expenses,	10 32
Total,	$127 05

This leaves a net profit of $370.83 on two acres or $185.41 per acre.

Fungous Diseases.

There is but one fungous disease that is in any degree serious upon the strawberry. It is commonly referred to as the strawberry "leaf blight" or "rust" or "leaf spot" (*Sphaerella fragariae* (Tul.) Sacc.) The most appropriate common name is leaf spot for the disease manifests itself in spots over the leaf. Old beds of plants suffer more from leaf blight than new ones, and of course the modern practice of keeping a planting for one crop only and always taking layers from young thrifty plants reduces the chances of a serious attack to a minimum. Sometimes, however, young plants are injured to such an extent that the yield of fruit is greatly reduced.

The diseased spots are dark purple when they first appear and later become gray or white in the centre. The disease is most active in August and September, though some spots may be found at almost any season of the year. Varieties differ greatly in their susceptibility to attack by leaf spot, so that it is wise to make a selection of the more resistant varieties where the disease is troublesome.

Treatment:—Spray the young plants with Bordeaux mixture when new growth begins and repeat two or three times at intervals of

about three weeks. If the plants are to be held for a second crop, it becomes necessary to spray again the second season as in the first, deferring the treatment at planting time until the crop is removed.

Insects.

The greatest damage to strawberries due to insects is that occasioned by white grubs in the soil. These are the larvae of the common May beetle or "June bug," and other species that feed upon the roots of the plants. The insects are seldom found among strawberries unless sod land has been used, for the beetles lay their eggs in sod and the grubs feed upon roots until their third year.

Treatment:—It is clear that these insects should be avoided by using land that has been under the plow and cultivator for at least three years and to keep the strawberry plantation free from weeds and grasses. When a bed is found infested with grubs, the sooner it is destroyed the better.

The Crown Borer (*Tyloderma fragariae* Riley) attacks old plants. The borer is the larva of a small brown beetle one-sixteenth of an inch in length. It makes its appearance in June or July, hatching from an egg laid by the beetle at the crown of the root. The white legless borer eats its way into the crown of the plant and feeds there until it is ready to pupate.

Treatment:—A plant attacked cannot be saved, hence taking up and burning the weakened plants is the best treatment.

The Root Louse (*Aphis forbesi*, Weed). This insect has done serious damage in Illinois, Ohio, Maryland, Delaware and New Jersey. It has also been observed in Pennsylvania and Kentucky. Its destructive work is most likely to be found in sandy soils. Its presence is not suspected until many dead and sickly plants are observed spotting the field. An examination of the soil and roots of sickly plants in the summer or fall will reveal brown ants and many black plant lice on the roots. The ants do not injure the strawberry plants except in an indirect way by caring for the root lice for the same reason that a man will care for a cow.

Treatment:—Land known to be infested with this insect should not be planted to strawberries. Runners for planting should not be taken from infested beds. When a bed of strawberries is discovered to be infested with root lice, the entire bed should be plowed under as soon as practicable, for no successful remedy can be applied profitably.

RASPBERRIES.

All the varieties of raspberries cultivated in the United States are referred to three species, one is the European raspberry, *Rubus*

Idaeus, a red fruited species with varieties of a yellow or whitish color. Formerly the varieties of red raspberries cultivated in this country were all of this species, but recently they have lost favor and are not much planted. Antwerp, red and yellow, Belle de Fontenay, Fastolf and Brinkle's Orange may yet be found in some nurseries, and in cultivation in the warmer parts of our country. The hardier and popular varieties of red raspberries like Cuthbert, Hansell, Herstine, Turner, Loudon and Miller are descendants of our native American red raspberry, *Rubus strigosus*. The best yellow variety of this species is Golden Queen, and is a heavy bearer. The black raspberries, blackcaps, are varieties of our native Thimbleberry, *Rubus occidentalis*. The acreage in blackcaps is much greater than that or red raspberries. The leading varieties at the present time are Gregg, Ohio, Mammoth Cluster and Kansas.

Varieties of the red and black raspberries have been crossed, producing hybrids with purple canes and purplish red berries. These hybrids having formed naturally and in cultivation, have been accorded the distinction of a botanical species under the name of *Rubus neglectus*. The plants propagate either by suckers like the red raspberry or by "tips" as the blackcaps do. Prominent varieties of this type are Shaffer, Philadelphia and Columbian.

The strawberry-raspberry recently advertised among novelties, is *Rubus rosaefolious*, a half hardy species in this latitude. It should be regarded as nothing more than an ornamental plant with an extended flowering period, ripening insipid fruits from August to October.

Soils.

Almost any good soil will give satisfaction with raspberries. What has been said about soils for the strawberry applies equally well here, for these two fruits may often be found side by side in nature. A well drained sand loam, or gravelly loam is well suited to this fruit. Many of our peach growers are growing excellent crops of raspberries on their peach soils, preferring the elevated lands to the bottom lands which are inclined to be wet without proper drainage. Such wet soils are the most unpromising of all soils, even though the raspberry is known to require moisture. A soil that is rich in humus is more retentive of moisture than a thin, light colored soil; land that is full of stones too small to pick off and too large to be used for hoed crops may profitably be devoted to raspberries.

Fertilizers.

In the past it has been customary to use barnyard manure to fertilize land for raspberries, and in so far as this practice added humus to the soil, it is to be commended, but in the light of modern science which has revealed the true nature of the requirements of fruits, and by direct experiments which have shown the superior results obtained from the use of potash and phosphoric acid instead of nitrogenous fertilizers, the modern fruit grower makes a judicious use of wood ashes and dissolved rock and reserves the barnyard manure for other crops.

The amount of fertilizer for an acre can be determined only by direct experiment, but a safe guide may be found in the following proportions: Nitrogen 3 per cent., phosphoric acid 6 per cent., potash 8 per cent.; this may be applied by the use of

40 pounds nitrate of soda.
300 pounds dissolved rock.
100 pounds muriate of potash.

In soil rich in humus the fruit yield would not likely be affected by the use of nitrate of soda, hence this ingredient could profitably be omitted in such cases. On the other hand the quantities of dissolved rock and potash could be increased two or even three times with profitable results. Instead of muriate of potash, 1,000 pounds of unleached wood ashes may be used for every 100 pounds of the muriate.

Propagation and Planting.

Red raspberries are propagated by means of the suckers which are freely produced from underground root stocks. It is best to take these from young plantations, as plants of long standing are likely to be contaminated with diseases and insects which would be transmitted with the suckers. Nurserymen who require a larger number of small plants than suckers afford, resort to the root cutting method of propagation. Roots about one-fourth of an inch in diameter are cut into pieces one or two inches long. This is done in the fall and the cuttings are carried over until spring by stratification. In April or May they are planted in nursery rows where they will make excellent plants with one season's growth.

Blackcaps are propagated by using the tips of the long canes of the season. These tips touching the ground during September and October produce a quantity of roots. Canes which do not naturally reach the ground are pegged down; if the ground is mellow better

plants are obtained than could be expected in compact soil. The blackcaps can also be propagated by root cuttings as described for red raspberries, but should be started in the early spring in mild hotbeds.

The purple cane raspberries are usually propagated like the reds, but the tips of canes may be rooted as with the blackcaps.

Spring planting is preferable, but it is possible to obtain a full stand of plants by fall planting if only strong plants are chosen and these put three of four inches in the ground. Before spring growth begins the ground over the plants should be drawn away to have the buds of the new growth near the light. This ground is returned by cultivation later in the season. Planters usually choose the spring for blackcaps and fall planting for red raspberries. The plants should have the canes cut to two or three inches above the roots to insure the production of strong new canes from the base. It is a mistake to leave the whole cane which is likely to blossom and fruit in the first season and greatly weaken the plant for the future crop.

Raspberries are planted at different distances, according to the variety and methods of culture to be followed. The small growing varieties are planted 3x6 feet usually and for the larger kinds the distances may be extended to 4x8 feet. This disposition of the plants will permit cultivation in two directions and thus greatly reduce the amount of hand work among the plants.

Cultivation.

To obtain the best results from raspberries, they must be given as much care in cultivation as would be given a crop of corn. A berry patch in which the surface soil is allowed to become hard and compact, grown up with weeds and superfluous suckers, cannot be expected to prove very profitable or to give pleasure to the proprietor. The idea that because raspberries "grow wild in the woods" they may be neglected in the field is not in harmony with the true idea of cultivation. The proper culture of any plant requires that we provide and maintain every condition that will induce the best growth of the plant, perfect the largest and finest crop of fruit and facilitate the harvesting of the crop. This is not accomplished by permitting a field planted to raspberries, to become a bramble patch choked with weeds and dead canes.

By keeping the surface well tilled and clean the first season, the following spring a good tearing up with a suitable harrow will be sufficient for the beginning of the second season, otherwise the ground should be broken as early as possible with a one-horse plow

to a depth of three or four inches. The subsequent cultivation is best done with a spring tooth cultivator.

Pruning.

The canes produced the first season bear the first of the next season, and after harvest such canes die and may be removed at any time after the fruit is picked. Usually this work is deferred until early spring before new growth begins. In regions where anthracnose and other fungous diseases prevail it is better to cut out the old wood promptly after harvest and burn the brush, such cleaning out of diseased wood is a profitable practice to follow with all kinds of brush fruits.

Expert raspberry growers practice pruning of the new canes as they are forming in the summer by pinching or breaking off the tender head or tip of the shoot when it reaches the height of two or two and a half feet. This practice results in the forming of strong lateral shoots from a stiff base and increases the amount of fruit bearing wood for the next season. This pruning cannot be completed at one going-over of the patch, but must be attended to at brief intervals to catch the new canes at the proper height. At the time of the spring pruning of old wood, the numerous laterals are shortened by cutting off the weak ends.

Raspberries are not mulched or given special protection for the winter in this State. The more tender varieties are not planted.

Harvesting.

Raspberries must be picked about every two days to make sure that they will not be over-ripe, for a few such soft fruits in a box will greatly reduce the selling price. All pieces of leaves dried or crippled berries should be kept out of the boxes. The methods of handling strawberries described under the discussion of that fruit will apply to the raspberry also. Raspberries come into season just as the last strawberries are being harvested, therefore, the same force of pickers can be continued in service where both berries are grown extensively.

In Western New York where blackcaps are grown extensively for evaporating, the crop is gathered by the use of the berry harvester. "This consists of a canvas tray some three feet square, there being only enough wood about it to form a frame work and enable it to be moved about. Under the corner, which rests on the ground, there is a sort of shoe of wood enabling it to be slid along easily from bush to bush. In one hand the operator carries a wire hook with which the bushes are drawn over the canvas or lifted up if too low down or in the way. In the other hand is a bat resembling a lawn

tennis raquet with which he knocks off the ripe berries. This is merely a canvas-covered loop of heavy wire fastened in a convenient handle."* This kind of berry culture has not yet been taken up in Pennsylvania.

Yields and Profits.

Under similar conditions, blackcaps are likely to yield more heavily per acre than the reds, but the difference is not necessarily great and depends principally upon the varieties used in making the comparison. The average yield per acre is about 2,500 quarts, but the wide range of yields in actual experience make it difficult to determine what success may be expected in a new field. Good treatment with the best varieties should produce 3,000 quarts. The expense of cultivating raspberries is much less than that of strawberries, and when once planted, a patch may be kept in profitable condition for a number of years. The income from an acre of raspberries is usually reported at from $50.00 to $150.00. Plantations are profitable for eight or ten years ordinarily, but some have been maintained for fifteen or twenty years.

A comparative view of the yields of varieties and the variation from year to year for a period of five years is shown in the following:

Table of Records of 12 Plants of Each Variety of Raspberries Grown at Pennsylvania Experiment Station.† Weights are Given in Grams.

Varieties.	1897.	1898.	1899.	1900.	1901.	Average.
Shaffer, purple,	25,240	18,380	14,090	13,645	21,550	18,581
Cuthbert, red,	25,675	12,800	8,545	6,320	5,840	11,836
Brinkle's Orange,	8,630	18,240	15,815	8,470	7,935	11,818
Wineberry,	8,480	8,800	1,000	6,325	32,010	11,323
Golden Queen, yellow,	16,955	8,750	9,200	8,120	11,540	10,913
Kansas, black,	17,340	10,875	9,045	7,695	7,635	10,518
Caroline, yellow,	19,610	13,025	8,270	8,380	2,220	10,301
All Summer, red,	8,670	21,390	5,710	8,370	7,300	10,288
Turner, red,	12,680	11,570	8,815	8,530	6,805	9,680
Columbian, purple,	20,190	12,270	6,750	1,890	6,600	9,540
Ohio, black,	21,900	12,990	3,000	5,700	2,820	9,282
Hansell, red,	16,400	10,500	5,135	5,590	3,180	8,161
Lovett's, black,	4,420	8,340	5,100	6,630	7,890	6,476
Gregg, black,	10,830	9,360	5,160	4,620	1,800	6,354
Brandywine, red,	12,195	7,740	3,695	4,770	2,370	6,154
Mammoth, black,	11,200	6,525	4,945	5,145	2,430	6,049
Philadelphia, red,	10,655	4,390	3,195	4,565	2,905	5,142
Ada, black,	7,885	5,150	4,020	4,395	2,885	4,867
Rancocas, red,	13,320	3,335	1,440	1,255	3,830	4,636
Marlboro, red,	11,615	2,420	1,420	3,750	1,655	4,172
Thompson, red,	5,310	2,835	960	4,720	2,555	3,276
Herstine, red,	4,150	3,360	2,770	2,625	3,000	3,181
Loganberry,‡	840	360	60	5,520	8,130	2,982

*Cornell Exp. Sta., Bul. 57, 1893.
†Report Pa. Exp. Sta., 1902-'03.
‡After 1899, the Loganberry was given good winter protection. The considerable decrease in yields for all varieties in 1899 was due to the very severe winter preceding. The effect was observable for two years.

Varieties.

Red raspberries bring higher prices in the markets than blackcaps. This is partly due to the fact that the yield per acre of the former is less than of the latter, but also because the reds have a superior quality. For a market, when prompt delivery to the consumer is possible, it is more profitable to grow the reds, but for shipping, the blackcaps will give better returns. The purple berries are large and borne on large vigorous bushes, but their color is less attractive than red or black and therefore such varieties should not be planted extensively. The yellow varieties of the red type are heavy bearers also, but the experience in the fruit market discourages the planting of varieties with yellow berries. Everbearing raspberries like everbearing strawberries are to be regarded as novelties for the home garden and not as business varieties for the fruit grower.

The leading varieties at the present time are as follows:

Reds.	*Blackcaps.*	*Purple.*	*Yellow.*
Cuthbert,	Cumberland,	Columbian,	Golden Queen.
King,	Eureka,	Shaffer.	
Loudon,	Gregg,		
Miller,	Kansas,		
Worthy.	Palmer.		

Fungous Diseases.

There are several fungous diseases affecting the raspberries, and it is important that the fruit grower should acquaint himself with them to recognize them with certainty and be able to treat them properly if he wishes to remain in the business. Suitable soils and clean culture may almost be regarded as a guarantee against the invasion of fungous diseases, for a healthy growth of bushes will ward off an attack of fungi unless the latter are favored by carelessness and neglect.

Anthracnose.

The most serious enemy is anthracnose (*Gloeosporium venetum*). It may be found upon young canes when but a foot high, but is more easily studied to make its first acquaintance in September or October. These diseased canes are spotted from tip to base, the spots average in size about one-fourth of an inch in diameter with a gray or dirty white centre and a margin of a dark brown to a bright purple color. This fungus prefers the black raspberry, but will also attack the purple varieties and blackberries. Red varieties are not attacked by anthracnose. But few plants are ever killed outright by this disease, but the crop of fruit is very greatly reduced when anthracnose prevails.

Treatment.—The cutting out of old canes and badly diseased new ones as soon as the crop of fruit is harvested and burning the brush,

is the very best treatment that can be recommended. Of course if the case is one of long standing, and the bushes are unthrifty the patch should be destroyed and new plants be obtained from healthy stock and planted in new ground.

Some fair results have been recorded in the use of Bordeaux mixture in checking the destruction caused by anthracnose by spraying the bushes from the time the new canes are six inches high until the first fruit approaches ripeness at intervals of two weeks. The expense of this treatment practically prohibits its general adoption.

Rust.

A disease common to raspberries, blackberries and dewberries frequently called orange rust on account of the orange colored fruiting areas on the under side of the foliage. It is commonly seen upon native plants in fence rows, roadsides or neglected fields from which it spreads to plants under cultivation. The fungus (*Puccinia peckiana* Syn. *Caeoma nitens*) has a perennial mycelium living within the canes and spreads to new growth internally by this means and externally by means of the orange colored spores.

Treatment.—Diseased plants suffering from this rust cannot be benefited by spraying with a fungicide because the parasite is doing its mischief in the interior of the branches. Spraying could serve only to keep clean the plants which are not yet infected. Diseased plants should be grubbed out and burned. This applies to wild plants in the vicinity also, and if it is attended to upon the first outbreak of the rust it may be prevented from spreading to many plants.

Leaf-spot.

Leaves of raspberries, blackberries and dewberries are often spotted with many small gray dots of dead tissue caused by a fungus (*Septoria rubi*). This is not ordinarily a serious enemy of these fruits , but it has at times been responsible for enough damage to lead experimenters to search for a remedy. The use of Bordeaux mixture, the most promising remedy, has not been very successful.

Root Gall.

Raspberries and blackberries are subject to this disease, but more especially the red and purple varieties of raspberries. Large galls form upon the roots and when many of them appear the plants suffer greatly, and may die. These galls have not yet been closely studied, but it is assumed they are caused by a low form of fungus similar to the one (*Dendrophagus globosus*), shown by Prof. J. W. Toumey* to be the cause of crown gall on the peach and apri-

*Bul. 33, Arizona Exp. Sta., 1900.

cot in the United States. The nature and position of this disease is such that no remedy is practicable, but plants suffering with root gall should be burned and the infested ground not be used again for fruits for a period of three or four years.

Insects.

Cane-borer (*Obera limaculata*). In June the tips of young canes are seen to wilt, and upon inspection, it may be observed that about six inches below the tip the new cane has been punctured. This was done by a slender black beetle one-half inch long, when it deposited an egg. A row of punctures is made above and below the place when the egg is inserted. When the eggs hatches the borer works downward in the cane and by autumn reaches the roots where it pupates and remains until the following spring.

Treatment.—It is a simple matter to cut off the wilted cane tips as soon as they are observed and destroy them.

Cane Maggot (*Phorbia Sp*). In May the wilting of young shoots indicates that a small fly, resembling the common house fly, has recently been abroad and laid an egg in the angle of a leaf and stem close to the growing tip. Within a few days a maggot hatching from the egg burrows into the tender cane; it then works downward a few inches, and then to the bark where it makes an interior girdle that results in the wilted tip. From this point the maggot continues to burrow to the base of the cane, pupates and remains until the next spring.

This insect is not to be confounded with the preceeding. The simple treatment in this case as in that of the cane borer is to cut off and destroy the wilted tips, cutting low enough to get the maggot.

Saw-fly (*Monophadnoides rubi*). This insect also resembles the house fly and may be seen about raspberries and blackberries in May. Its eggs are laid within the leaf from the under side usually near the veins. The leaves become spotted with brown by the coloring of the tissue over the eggs. The larvae hatching from the eggs in about a week are light green and covered with spine-bearing tubercles. They feed upon the foliage and late in June go into the ground, pupate and remain there until the next spring.

Treatment.—When the presence of the larvae or slugs is indicated, the foliage should be sprayed with hellebore, one ounce to a gallon of water, being particular to have the spray reach the insects.

WINEBERRY.

The wineberry was introduced to cultivation as a new, small fruit in 1890 by John Lewis Childs. It is closely related to the raspberry, being a species of Rubus (*R. phoenicolasius*) found in China and Japan. The stock in this country was raised from seed collected

from native plants in Japan, and in consequence of this the stocks is not uniform in character. The wineberry propagates readily by tip layers like black raspberries. The plants are hardy enough to stand our ordinary winters with protection. The fruit when ripe has a pretty, cherry red color, making it showy and attractive, but it has an acid taste and an unpleasant flavor, so that it has not taken a prominent place among small fruits. It is serviceable as an ornamental shrub, or a novelty in the home garden.

LOGANBERRY. (Raspberry-Blackberry.)

The Loganberry attracted considerable attention a few years ago because of its peculiar origin which was definitely known. It has been vividly described as a small fruit of which the vine has the habit of a dewberry, and leaves like a strawberry, the fruit looks like a purple blackberry and tastes like a raspberry. There is certainly a remarkable combination of blackberry and raspberry characters in this hybrid. It was raised by Judge J. H. Logan at Santa Cruz, California, in 1881, from a seed of the Aughinbaugh blackberry, accidentally fertilized from the Red Antwerp raspberry.

The plant is propagated from "tips" or single eye hardwood cuttings. If a cane is burried for some distance, roots are formed at each bud, but the resulting plants are not so strong as the tip plants.

The canes having the trailing habit of dewberries make it necessary to train them upon some sort of a trellis to admit cultivation and keep the berries away from the ground. The canes grow from six to twelve feet in a season, and even longer in rich soils.

At the Pennsylvania Experiment Station, the Loganberry has not been hardy enough to stand the winters without protection. This is the common experience in the eastern States. The fruit is as large as a blackberry, but it is too soft for shipping, therefore, it is not adapted for commercial planting. The flavor is a peculiar one that is not universally liked. The effect of winter protection of the canes is demonstrated in the table of yields for five successive years given in the table on page 34.

BLACKBERRIES.

Blackberries are peculiarly American as to their origin and cultivation. Several species of Rubus are concerned in the development of the varieties now being cultivated. The principal species has long been known as *Rubus villosus*, but has recently been assigned the name of *R. nigrobaccus* by Bailey*. This is the common highbush blackberry of our eastern States. It is a variable species and several forms may be recognized among the cultivated varieties. Those

*Cyclopedia of American Horticulture, p. 1583, 1902.

which closest resemble the species are classed as "Long-cluster blackberries," and are represented by Ancient Briton and Taylor. *R. nigrobaccus* var. *albinus* is a white fruited blackberry found wild. Several varieties have been introduced as novelties of which the crystal white is the best, but none have commercial value. The "short-cluster blackberries" are the leading varieties in cultivation and are considered, botanically, as *R. nigrobaccus* var. *sativus*. Representatives of this class are Agawam, Erie, Kittatinny, Lawton and Snyder. The leafy-cluster blackberries are varieties of *R. argutus*. The canes are shorter than in the preceeding, and simple leaves are mingled with the fruit in the cluster. The Early Harvest and Allen are worthy examples. Another class of varieties with characters intermediate between blackberries and dewberries are of hybrid origin, *R. nigrobaccus X villosus*. The plants have a low spreading habit and are represented by Rathbun, Wilson's Jr., and Early Wilson. The Sand blackberry, *R. cuneifolius*, represented by the variety called Topsy or the Tree blackberry is a sturdy shrub with many strong recurved prickles. The fruit is medium size, sweet and good, but cannot be recommended for other than the home garden. It is catalogued under the names of Topsy or Child's Tree.

Soil.

The blackberry thrives best in a mellow, clay loam, having some depth. It succeeds also on gravelly soils where there is considerable moisture as in spouty hillsides. Such land must have the best surface drainage and receive deep preparation. Flat lands that are inclined to be wet should be tile drained, or like any other fruit, the blackberry will winter-kill badly. The fruiting of the blackberry is seriously reduced by drought in July or August and for that reason it is well to use a cool northern exposure when it is available.

Fertilizers.

Land should receive about the same treatment with fertilizers for this fruit as recommended for the raspberry. If in preparing the soil for the plants, 10 to 15 two-horse loads of manure are used and the soil is fairly well supplied with humus, it is likely that the best returns will come with the use of potash and phosphoric acid during the fruiting years of the patch or plantation.

Propagation.

Good plants are obtained by taking the suckers that grow up about the bushes, or by making root cuttings. The former method is almost universally practiced among commercial growers, but nurserymen who seek to grow the largest number of plants from the

smallest number of stock bushes, adopt the cutting method. The root cuttings make the better grade of plants because they have a better supply of fibrous roots at the time of transplanting and consequently fewer plants will die. Roots the thickness of a lead pencil are lifted in the fall, cut to two inches in length and stored until spring. At an early date they are planted two inches deep in rich, mellow soil and at the close of the season each cutting will have made a well rooted plant. Stronger plants are made by using bottom heat to start growth from the cuttings in March and April. It is best to set the plants, either suckers or root cuttings, in the spring as all such small plants are likely to be heaved out in an open winter. If it should be desirable to plant in the fall the roots should be covered about six inches with soil which is to be removed in the spring when the ground warms up.

Setting the Plants.

Blackberries are set at various distances, according to the vigor of the variety planted and the method of culture to be followed. The large growing varieties in strong land are planted in hills seven or eight feet apart each way. This is ample space and affords easy cultivation and easy picking of the crop. If less space is allotted to each plant, blackberries may be set 4x8 feet apart, and the smaller varieties may be planted as close as 2x5 feet apart. The closer planting will of course yield more fruits per acre on account of the greater number of plants, but after the bushes are well developed, unless the denser plantations have been thinned out, the wider planting will produce the larger quantity of first class fruit.

The land is furrowed with a plow to a depth of six inches, having previously been prepared by deep plowing and thorough harrowing. The roots should be set three or four inches deep by tramping the soil firmly over them.

Three or four canes may be permitted to grow, but all others appearing should be cut away, strong canes formed the first year may be expected to bear fruit in the second year. It is a good practice to pinch off these canes when they are two and a half or three feet high.

It is not necessary to devote the land exclusively to blackberries during the first two years. Some other crop like potatoes, cabbage or such other low growing vegetable, or even strawberries may be grown among the blackberries. In this manner the land may be made to yield profit while the stand of blackberries is developing.

Cultivation.

Any crop that is dependent upon a good supply of moisture for its proper development requires that frequent cultivation that makes

for the conservation of the moisture in the soil. The blackberry matures its fruit in the hottest and often the dryest time of the year, hence a small or large crop of berries may be effected by much or little cultivation. This tillage should be kept up persistently during the spring and early summer previous to the ripening of the crop, for there is little opportunity to do this work after picking begins. It is a good thing to run through the patches after the crop is off to loosen up the ground which has been tramped down by pickers.

Cultivation should at all times be shallow, because deep cultivation tears the roots and results in numerous suckers springing up between the rows.

Pruning.

As already indicated, the young canes should have their tips pinched off when they reach the height of two or three feet; such summer pruning is practiced annually. The result of such heading off is the formation of several laterals branching from a strong stout cane. The following spring these laterals may be shortened from 18 to 24 inches in this manner thinning the fruit and insuring the finest quality of berries. This system of pruning followed regularly will maintain low stiff plants that will require no stakes or trellis to make cultivation and picking convenient.

Whether or not summer pruning is practiced, it will be annually necessary to cut out the old dying canes which have just borne fruit. This may be done as soon as the crop is off, but certainly it should not be delayed until the new growth appears in the spring. The earlier removal of unnecessary wood always reduces the chances of disease and insects becoming serious factors in the culture of berries.

If the canes are permitted to make their full growth, it will be necessary to provide a strong and durable stake six feet long driven well into the ground for each bush, or to construct a wire trellis using substantial posts and about two or three wires as in a grape trellis.

Mulching.

It is not necessary to give any winter protection to blackberries in Pennsylvania. The laying down of canes and mulching with earth or straw, as commonly advised in publications, applies to only northern countries or such tender varieties of berries that are not recommended in this bulletin.

In small patches where cultivation with horse power is impracticable, a good way to conserve moisture is to mulch with cut grass or green clover. In some western States such mulching is practiced in connection with cultivation, covering with the mulch that ground which cannot be reached with the cultivator.

Harvesting.

The picking of blackberries does not differ greatly from that of the raspberry; but one essential point to be observed is to instruct all pickers to take the blackberry, not when it is black, but when it is ripe, that is to say, blackberries are not ripe as soon as they are black. Many person refuse blackberries because they are sour; such people certainly have had experience with unripe fruit, for the thoroughly ripe blackberry is delicious, and if pickers will exercise a little discretion they will put into the baskets only ripe fruit, and a better market will be the result of such a practice. Blackberries should not be picked when they are wet nor should they be permitted to heat in the sun.

Yields and Profits.

Blackberries yield more heavily than raspberries. They are likely to yield enough in the second season to pay for the expenses involved in establishing the plantation. The crop may be expected to increase from year to year until about the fourth year, after which it is likely to remain about uniform for fifteen or twenty years more. It may last a life time. Of course if cultivation is neglected, weeds and dead wood smother the plants and insects and diseases are given full sway, such good results would not be realized. Blackberries yield from 100 to 300 bushels of fruit to the acre. Therefore with good treatment one may count on an average crop of 200 bushels per acre. Selling this fruit in a market where it will bring from eight to twelve cents per quart, should make it easy to clear two or three hundred dollars per acre.

Varieties.

Under the botanical consideration of the blackberry, the varieties were classified according to characteristics of plant, inflorescence, etc. The student of the profits of berry culture is more concerned in the hardiness, productiveness and time of ripening of varieties. From the reports of berry growers throughout the State of Pennsylvania and the corroboration of the tests at the Experiment Station in this State, the following list, including early and late varieties, is selected as being both hardy and productive:

Allen,	Kittatinny,	Rathbun,
Ancient Briton,	Mercereau,	Snyder,
Early Harvest,	Minnewaski,	Taylor,
Erie,	Ohmer,	Wilson.

The only way to select the best varieties for a given soil and locality is to grow them in a limited way and choose according to the experience obtained with them. The very early varieties beginning to ripen their fruit in this State about the first of July are:

Allen,
Early Harvest,
Wilson Early,
Wilson Junior.

Medium varieties beginning to ripen fruit about July 15 are:

Ancient Britton,
Erie,
Kittatinny,
Mercereau,
Minnewaski,
Rathbun.

Late varieties beginning to ripen fruit after July 20 are:

Child's Tree,
Ohmer.
Taylor.

Table of Blackberries prepared from records taken at State College, Pa.

Varieties.	First flower.	First ripe.	Last ripe.	Yield, 6 plants, in grams.	Average weight of berry—grams.	Vigor of plants. Scale 1—10.
Agawam,	May 31,	July 18,	Aug. 27,	8.475	.....	8
Allen,	June 7,	6,	20,	6.240	2.10	6
Ancient Briton,	1,	19,	27,	8.745	.....	8
Child's Tree,	7,	22,	29,	10.815	2.60	8
Crystal White,	2,	17,	29,	3.318	1.82	6
Dorchester,	5,	15,	27,	3.218	1.30	8
Early Harvest,	2,	8,	27,	9.552	1.95	6
Early King,	May 29,	14,	27,	6.528	2.28	7
Eldorado,	27,	16,	27,	7.518	2.93	8
Erie,	31,	19,	27,	8.600	3.65	7
Kittatinny,	28,	16,	29,	8.820	3.53	9
Lawton,	25,	20,	25,	10.400	1.35	7
Lovett's Best,	June 3,	23,	25,	9.400	2.85	7
Lucretia (dewberry),	May 25,	3,	13,	9.150	3.13	8
Luther,	June 3,	16,	27,	6.108	2.68	7
Maxwell's Early,	4,	16,	4,	3.390	.....	4
Rathbun,	May 31,	17,	27,	4.085	1.08	7
Snyder,	25,	16,	27,	5.832	1.95	7
Wilson Early,	26,	15,	27,	8.315	2.54	7
Wilson, Junior,	28,	16,	6,	2.560	.....	7

The figures in the above table may be used comparatively in estimating varieties. The dates of flowering and first ripening vary considerable from year to year according to weather conditions about that season of the year. Yields per acre could be estimated from the yields given for six plants by allowing 550 grams to the quart of fruit, but it should be borne in mind that such estimates based upon results from small areas are always high. The plants

stand five by six feet apart. The yields given indicate yields per acre ranging between 1,250 and 5,000 quarts. The comparative sizes of the run of the berries are shown in the column of berry weights and the vigor of the plants is scored on the scale of ten in the last column.

DEWBERRY.

The success of small fruit culture has brought into cultivation that despised brier of neglected and abandoned fields. The dewberry, so "blessed" by the farmer, is received kindly by the fruit grower to aid him in securing a fortune.

The dewberry like the blackberry has varied greatly in nature. It differs mainly from the latter in its trailing habit. This habit is the greatest obstacle in its cultivation. That it is closely allied to the blackberry is shown in the fact that hybrid forms are found wild and in cultivation. Four species are now being developed and several varieties are worthy of extensive planting. The Northern dewberry is *Rubus villosus* (formerly *R. Canadensis*). Several forms of this have been distinguished with varietal names as Windom or Cook's Hardy, Lucretia's Sister and Geer. The leading variety of all the dewberries, Lucretia, is distinct enough to make a new type, which Bailey has described as *R. villosus* var *roribaccus*.

The Bartel type (*R. invisus*), the Southern dewberry (*R. trivialis* and the Western dewberry (*R. vitifolius*) are all in the hands of enthusiasts, but none of their varieties can be recommended for extensive planting.

The Lucretia dewberry serves to lengthen the season of blackberries and fills a small gap between raspberries and blackberries.

Propagation of the dewberry is by rooted tips. The young plants are planted with blackberries or in fields by themselves putting them four by six feet apart. A trellis of one or two wires is used to train the trailing canes high enough to keep the fruit above ground, and to direct them in narrow rows so that cultivation may be possible between the rows. The preparation of the soil for planting and after cultivation is the same for this fruit as already given for the blackberry.

The time of ripening, yield, etc., of the Lucretia dewberry the only variety grown extensively, are given in the table for blackberries on a preceeding page.

The fungous diseases and insect enemies which are likely to attack this fruit seriously are referred to in the following pages.

Fungous Diseases.

The principal fungous diseases of the blackberry and dewberry are the same as those of the raspberry and are treated in the same manner. It is very seldom that any one of them attacks a planta-

tion with such force that spraying is called for since a judicious pruning out of diseased wood reduces the trouble and the new growth regains vigor to resist or overcome the iujury

Anthracnose (*Gloeosporium venetum*). See under raspberry.

Rust, Red or Yellow (*Puccinia peckiana*). See uuder raspberry.

Leaf-spot (*Septoria rubi*). See under raspberry.

Root Gall. See under raspberry.

Cane-knot is a disease, probably of fungus origin, which attacks the blackberry. In its appearance and behavior it suggests to mind the black knot on the plum. It is not of very frequent occurrence and the only treatment that can be recommended is to cut out the diseased canes as soon as discovered. It appears on bearing wood and prevents the maturing of the fruits. If permitted to take its own course, this disease soon spreads to other canes and becomes very destructive to the plantation.

Insect Enemies.

The insects which are ever injurious to blackberries and dewberries are the same as those discussed under the raspberry and the treatment there given applies equally to the blackberry.

THE GOUMI.

After ten years of trial, this novelty has not taken a very prominent position among small fruits. It is regarded as an oruamental shrub, very properly, but before it will be welcomed as a fruit it must be greatly improved in flavor.

The Goumi is a Japanese species of Elaeagnus (*E. longipes*). Nurserymen's catalogues sometimes list it as *E. edulis*. It is a shrub attaining a height of from four to six feet, perfectly hardy and produces an abundant crop of fruit the size of small cherries. The color of the fruit is a beautiful combination of red and yellow, making a most attractive feature of the shrub. There is an astringency about the fruit that makes it unpleasant, and all attempts made by the writer to induce people to use the fruit in some way by presenting it to them have failed to be complimentary to this newcomer. When cooked the fruit looses its only attractive feature, its color, and becomes a cloudy gray color. A jelly cannot be made from it, hence it will find few friends in the kitchen. The fruit ripens early in July and hangs upon the bushes until the end of the month.

BUFFALO BERRY.

Among the ornamentaI shrubs forced upon the attention of the small fruit grower is the Buffalo berry. Its botanical name, *shepherdia argentea*, has recently been changed to *Lepargyraea argentea*.

(Not much of an improvement but an evidence that it has not been neglected by the botanist). This is a hardy native shrub with many short twigs terminating in thorns. The fruit borne in clusters close to the branches, is small, yellow, or bright red and sour. A single large seed leaves but little edible pulp. It ripens in July and August. This shrub is closely related to the Goumi *Elaeagnus longipes.* both being members of the Oleaster family of plants. The Buffalo berry is dioecious, that is, staminate and pistillate flowers are borne on separate plants, and of course to get fruit, both forms of the plant must be planted side by side just as "staminate" and pistillate varieties of strawberries are grown together.

A place for this fruit will scarcely be made by removing from our gardens any of the better known berries, but where a rigorous climate prohibits the growing of currants the Buffalo berry would be welcomed.

JUNEBERRY.

Another novelty in the small fruit garden is the Dwarf Juneberry, *Amelanchier Botryapium*, which is a native shrub, very showy in April and May in swamps and moist soils, at which time the many racemes of white flowers attract the eye. It is known also as the shad-bush. A variety called Success is the leading one of several which have been introduced for cultivation for the fruit. The fruit has the size and color of huckleberries, though not as much flavor as the latter. It ripens in Pennsylvania late in June and continues in season until the middle of July. Robins are very fond of the fruit and will take a large share of it when only a few plants are grown.

The plants throw up shoots from below and may be propagated by separation or by hard wood cuttings.

CURRANT.

A few bushes of currants are always planted about a new home showing that there is a universal liking for some of this fruit. It is a very agreeable acid fruit to eat from the hand, and it is coming into favor for dessert to be eaten with sugar and cream. Its chief household use is in making jelly, pies and tarts and great quantities are converted into wine.

The varieties of currants in cultivation are referred to four different species of *Ribes.* The principal one is *R. rubrum* which is the ancestor of all the red and white varieties now cultivated. It is a native of Europe and North America, and in its wild state is not very different from the cultivated forms. It was not introduced into gardens until about 400 years ago, and even in 1597, Gerard indicates that it was rare in cultivation. Prominent varieties of the red currants are Red Dutch, Versailles, Victoria, Wilder, Cherry and

Fays. Varieties having white fruits referred to this species are White Grape and White Imperial. *Ribes nigrun* is the parent of all the black varieties. It is a native of Europe and Asia. Its early cultivation antedates that of the red species, being planted in gardens of France and Italy before the Middle Ages. Black currants rank higher in European countries than in America, and even here the best markets for them are where the foreign population is great. The black varieties have a peculiar taste that is not generally liked but they are supposed to have some medicinal properties not found in other varieties. Black Naples, Black Champion and Lee's Prolific are the leading varieties grown in America. There is a species of black currant, native in the northern States, *R. Americanum* (formerly known as *R. floridum*). Plants are often planted in gardens and resemble the European plants, but no varieties have yet been named. The fourth species referred to here is *R. aureum*, the Missouri or Flowering currant. This species has for a number of years been a favorite shrub for ornamental planting, and is greatly prized for its profusion of sweet scented yellow flowers in early spring. The fruit of the species is black and small, but a variety was recently found growing wild in Kansas by Mr. R. W. Crandall and for him was named the Crandall currant. In this the fruit is almost as large as cranberries, and have about the same red color. It is too sour to relish from the hand, but for people who like gooseberries and cranberries in stews and pies, the Crandall currant will give some pleasure.

The attention of the commercial fruit grower is directed here to the varieties of red and white currants as the only ones worthy of his planting.

Soil and its Preparation.

A cool, clayey loam is better suited to this hardy fruit than a warm, sandy soil. Currants thrive in the partial shade of overhanging trees or on northern slopes mainly because of the cooler conditions prevailing there. A strong, moist loam, such as clay loams usually are, with good natural or artificial drainage is well adapted to this fruit. Soils rich in plant food will give better results than poor ones. If only a few plants are set out for home use little consideration is given to the character of the soil, but it is always possible to chose a cool and shaded spot for the plants. If currants are planted for commerical purposes it is well to chose carefully with regard to the adaptability of the soil.

The preparation of the soil should have begun several years before planting by the cultivation of some vegetable crop. Such treatment always including liberal application of barnyard manure puts

the ground in the very best condition for a crop like currants which is to occupy the land for a long term of years. The plowing and harrowing should be done when it is dry enough to pulverize readily whether the planting is to be done in the fall or the spring. Spring planting is usually preferred, but fall planting may be done if the ground is in readiness and the plants are large and strong enough to pass through the first winter. Currants are perfectly hardy, but the heaving out of newly set plants always causes a considerable loss.

Propagation.

Currants may be propagated by means of layers, hardwood cuttings or soft wood cuttings. The most satisfactory method is by hardwood cuttings. The layer method insures strong plants without trouble, but the number of plants that can be obtained from a given bush is very small, hence it is but little resorted to except by the amateur in the home garden. So too with soft wood cuttings. The extra care needed in rooting them makes it an inconvenient method except in the nursery.

The general method, therefore, is with hardwood cuttings. These are cut of the season's ripened wood in September or early spring making the lengths about four to eight inches long. If cut in the fall, they are tied in bundles of twenty-five and buried in well drained soil with two or three inches of soil over them. Here they form a callus, and if they are buried with the bottom ends upwards, the callus is more quickly formed, being nearer the heat. The cuttings may be planted in a prepared cutting bed in the garden either in the late fall or spring as they may be carried over the winter where they have been buried. If they are planted in beds in the fall they should be carefully mulched for winter protection. This may be done by drawing the ground over the entire cutting and removing it from the tips of the cuttings in the spring. Not more than one or two inches of the cutting should extend above the ground when it is planted. When rooted, the cuttings must be weeded and hoed to favor their growth through two seasons. One-year old plants may be strong enough to transplant, but better success follows the use of two-year old plants.

Planting.

The proper distance for planting currants is four by six feet, three by six feet, or five by five feet according to the vigor of the variety planted and the choice of the planter. The ground properly prepared may be marked out by a light furrow. The plants are set by making a hole with a spade deep enough to accommodate all the roots. Good soil should surround the roots and be tramped firmly

about and over them. After this a little loose earth is kicked or drawn over the tramped surface to serve as a mulch and prevent evaporation of moisture. If planting is deferred until spring, it should be started early to get the plants into the ground before sprouting begins.

Cultivation.

The care and attention to be given a patch of growing currants is not unlike that of any other young plantation. The cultivator should be used frequently to keep a loose earth mulch and destroy the weeds before they send their roots deep or make much top. What the horse power fails to accomplish must be promptly attended to by hand with hoes.

The surface tillage should be shallow, especially near the plants, for the roots are near the surface. It is a good practice to mulch the plants during the growing season to keep the roots cool, retain moisture, and by its slow decay furnish a quantity of humus to work into the soil. Any convenient kind of litter may be used in this way. Dry grass, straw, weeds, loose manure, or even coal ashes will serve for this purpose. There is an objection to such mulching in that it favors the breeding of insects. Where insects are troublesome this mulching should be omitted. Grass growing up in the interior of bushes is a serious hindrance to the growth of new wood in the currants. The grass is a troublesome weed to remove when it has once established itself therefore the early care of the plantation must be ordered aright for its continued success.

A planting of currants should continue to be profitable for a term of 25 or 30 years.

Fertilizer.

As a matter of fact, the only fertilizer that currants get, as a rule, is an occasional dressing of barnyard manure. This is good so far as it goes, and when the plants are run down in vitality, is one of the best fertilizers to be applied. When, however, the bushes have reached maturity and are capable of yielding a good crop of fruit, then the application of potash and phosphoric acid will show better results than can be obtained with barnyard manure alone. Heavy applications of nitrogenous manures render currants and gooseberries more liable to the attack of mildew.

For currants or gooseberries in good condition so far as the plants are concerned an annual application of 200 pounds of dissolved rock and 100 pounds of muriate of potash will give excellent returns for the additional expense. When unleached wood ashes are more conveniently obtained than muriate of potash, the former may be substituted at the rate of one-half ton to the acre.

Pruning.

Unlike raspberries and blackberries, currants bear fruit on young and old wood. So long as a cane or branch in a currant bush continues to bear fruit profitably it should not be cut away, but as soon as its vitality is being strained by the fruit hanging on it, it should be marked for the pruning shears, and in the fall or early spring all such weakening wood should be pruned by cutting it low. Thus we throw the entire force of the root system into the younger wood and in this manner year after year maintain a thrifty growth. The finer fruit is always on the younger wood, but the heaviest part of the yield is upon the old wood, hence by stimulating old bushes with the proper fertilizers, a finer and larger yield is harvested. Sometimes it is recommended to grow currants and gooseberries in the bush form with a single stem from the ground. Such plants lend some advantage in the culture, but they are short-lived because there is no opportunity to renew the head of the bush when the original wood becomes weak by overbearing. Plants trained to the single stem had all their lateral buds removed from the cutting or young plant when they were set out, to prevent any sprouting from the base. The bushes with a moderate number of canes springing each year from below the surface of the ground furnish a better opportunity to insure a succession of good crops of fruits. From six to eight good canes make a good bush for a space of ground, four by six feet. Two or three young canes may be permitted to develop each year.

The pruning of the currant then is a simple matter, thinning out weak and dead wood and shortening in ambitious canes that extend themselves beyond the usual dimensions of the variety.

Experiments on the thinning of fruits have shown that by clipping off the end half of the fruit clusters while they are small increases the size of the fruit, but unless a fruit grower has a special market for extra large berries, the expense of the practice does not warrant its adoption.

Harvesting and Marketing.

Currants are ready for market from the last week in June until the last week in July. The earlier pickings are best suited to the making of jellies while the fruit is a little under ripe. The riper fruit in July is sweeter and adapted for the dessert. Currants should be picked on the stem in all cases, and all twigs and leaves should be kept out of the boxes in which the fruit is marketed. When the berries are wet from dew or rain they should not be handled.

Yields and Profits.

The yields of currants vary greatly according to variety, treatment and richness of the soil. Few fruit growers give the currants anything but the most indifferent care and it is not surprising if the average yield with them does not exceed 75 bushels per acre. On the other hand, with well chosen soil, liberal feeding and judicious pruning, as much as 250 bushels of fruit have been harvested per acre. The prices obtained for currants fluctuate considerably from time to time, but an average price of eight cents per quart may be used in estimating the profits of an average crop.

The yields of varieties may be compared in the following results obtained from three mature plants of each variety at the Experiment Station, State College, Pa., in 1897.

	Grammes.
Reds.	
Cherry,	8,100
Fays,	9,480
Versailles,	13,585
Red Dutch,	13,691
Red Grape,	21,443
Victoria,	15,008
White.	
White Grape,	6,275
Black.	
Black Champion,	2,565
Black Naples,	2,805
Lee's Prolific,	3,210

Fungous Diseases.

Currants are blessed with a considerable degree of freedom from fungous diseases. It is very seldom that anything serious appears upon the bushes and the fruit grower is seldom concerned about the welfare of his plantation in regard to this destructive agency. However, since economic plants are so generally attacked by fungous diseases, the currant would lose respect if it did not have at least one enemy to properly associate it with other important fruits.

Leaf-spot.—There is scarcely a season or a bush that does not show some slight attack of a leaf-spot disease. Sometimes the attack is severe enough to cause all the foliage to drop and both the fruit and the vigor of the plant suffer heavily. This disease, or these diseases, for there are two leaf-spot diseases, occasioned by two fungi (*Septoria Ribis* and *Cercospora angulata*) make their appearance in July. Leaf-spot attacks all varieties of currants and gooseberries and may be recognized by numerous small, brown spots scattered about the foliage. These spots sometimes have white or light gray centres of dead tissues. When it is discovered that plants are suffering from leaf-spot it is wise to apply remedies in succeeding years. It is too late in the season to accomplish any good after the disease has begun to work mischief.

Treatment.—Bordeaux mixture has been successfully employed in preventing the attack of leaf-spot, but it must be applied as a preventive. The first application should be made soon after the fruit

is set and four successive applications made at intervals of a week or ten days. If the last occasion should be near the ripening period of the fruit it may be deferred until the crop has been removed.

Cane Blight.—A disease appearing in the last few years in the fruit sections of New York and New Jersey has caused considerable damage to currants. It is known as Cane Blight caused by a semi-parasitic fungus, *Nectria cinnabarina.* The first symptom of the disease is the wilting of the leaves and the premature coloring of the fruit in June. Later, the leaves turn yellow and drop. The canes die rapidly and become rough by the fungus breaking through the bark and forming pink tubercles which are characteristic of one stage of the guilty fungus formerly known as *Tubercularia vulgaris.*

Treatment.—It is known that the mycelium of this fungus lives in the tissues of the plants from year to year, hence no external application can reach the cause of this disease. The only treatment, therefore, that is advisable is the cutting out of all diseased plants and burning them. If only a part of a bush seems to be attacked, the healthy portion may be saved by pruning away only the diseased canes.

No part of diseased plants should be used for propagation, lest the disease be conveyed to new plantations.

Insects.

Currant Worms.—Under this common name we usually understand that the "imported currant worm" is meant. It is well known to every one who has grown currants or gooseberries, for it is the most serious insect enemy of these fruits. There is, however, also an American species of currant worm less commonly observed. Both are larvae of saw-flies; the former is *Nematus ventricosus,* and the latter is *Pristiphora grossulariae.* When the young leaves are forming in early spring the flies may be seen about the plants. The flies resemble the house-fly, but have four wings instead of two, and their bodies are prominently marked with deep yellow. When at rest their wings are brought together over the body. They lay rows of small white eggs along a vein on the under side of a leaf and in ten days these hatch and the tiny, green larvae begin feeding at once upon the tender foliage. When full grown the "worms" are three-fourths of an inch long, green, spotted with black. They then go into the ground and pupate. A second brood of larvae appears about the last of June and the insects pass the following winter in the pupa stage.

Treatment.—Several remedies are effectual in destroying currant worms. The first and safest is to spray the bushes with hellebore a vegetable poison. It is sometimes dusted upon the plants, but a more uniform distribution is secured by using one ounce to two gal-

lons of water and applying with a spray pump. This remedy must be used while the larvae are very young. The second remedy is kerosene, applied by means of a kerosene sprayer by which water may be forcibly mixed with the oil in different proportions. A twenty per cent. mixture is sufficiently strong to kill the largest larvae without injuring the foliage of currants or gooseberries. This is a very simple and easy remedy. The third remedy is suggested for use where no kerosene sprayer is at hand and the larvae have become too large to be killed with hellebore, then use Paris green in water at the rate of one-fourth pound to a barrel of water. This should be sprayed upon the plants with an ordinary spray pump.

Plant lice.—The young growth of currants are often observed to become very purple, some leaves being entirely purple on the upper side. By examining the lower side of such leaves, numerous plant lice may be discovered as the cause of the distortion and coloration of the leaves. Several species of plant lice work upon the currants; but the most common one is *Neyzus ribis.*

Treatment.—The use of kerosene, as described above, for the treatment of the currant worm is a very effectual remedy for the plant lice; of course the spray must be directed against the lower side of the leaves to come in contact with the lice. Another remedy is in the use of whale oil soap, taking one pound to seven gallons of water and spraying the plants as with kerosene. A second application may be necessary in a week or ten days.

Borer.—Like most fruits the currant is subject to the attack of a borer, *Sesia tulipiformis.* The parent insect is a clear winged moth that lays its eggs on the canes of the currant and sometimes the gooseberry. Small white larvae are soon hatched from these eggs and eat their way into the pith of the stem where they feed until fall. They then pupate and the moth appears the following spring. The canes attacked show a decided weakness in growth.

Treatment.—By careful systematic pruning out of weak wood, all canes attacked by such borers are removed. It is important to cut low enough to remove the borer with the prunings, and then nothing more is needed, in fact nothing better can be recommended.

Four-lined Leaf bug.—In the past few years this insect has attracted attention upon currants. It has received several common names, but is identified as *Paecilocapsus lineatus.* It is an insect with a piercing proboscis as all true bugs have. It is one-third of an inch long, having a yellow back with four black stripes running lengthwise over it. Eggs are laid in the middle of summer and hatch the next spring. The young appear in May and are bright red in color and feed upon young leaves, causing a brown area to form in the tissue. They also attack the gooseberry.

Treatment.—These insects may be easily jarred from the bushes

and caught in pans containing kerosene. The bushes may be sprayed with kerosene as described for the currant worm above.

Currant Leaf-hopper. On the under side of leaves may be found small white insects commonly known as Leaf-hoppers (*Empoa albopicta*). They are not more than one-eighth of an inch in length. They suck the juice from the under side of the leaves and cause them to appear gray on the upper surface. Gooseberries also suffer from the attack of these Leaf-hoppers.

Treatment.—Kerosene, kerosene emulsion or whale oil soap, as already recommended upon currants, may be effectually employed against these insects.

San Jose' Scale.—This insect should have been placed at the head of the list of insect enemies of the currant and the gooseberry; in fact, it must be considered the worst insect enemy of nearly all our fruits. Every fruit grower should become acquainted with the San José Scale, *Aspidiotus perniciosus,* to be able to recognize it when it attacks his plants. It may be briefly described as a very small circular scale, usually gray, but sometimes black in color. This scale covers a yellow legless and wingless insect, that feeds by sucking the juices of the plant through a delicate proboscis. Several closely related insects resemble this one so much that only experts can identify them with accuracy. The San José Scale multiplies so rapidly that in a single season enough of these minute insects may be generated upon a currant bush to absolutely kill it. They locate upon the stem chiefly, but may appear upon the fruit and the leaves.

Treatment.—Young plants from the nursery bearing scales should be fumigated with hydrocyanic acid gas. Badly infested bushes in a plantation should be cut out and burned. Others may be treated with lime-sulphur and salt, as usually recommended in spray calendars.

GOOSEBERRY.

The gooseberries grown in this country are all descendants of three botanical species, one of which is European, *Ribes Grossularia* and the other two are American, *R. oxyacanthoides* and *R. Cynosbati.* Some varieties are hybrids between two of these varieties and when they occur between the European and an American species and possess essentially the characters of the American types, they are classed as American varieties.

The varieties of *R. Grossularia* have been handed down or originated during about four hundred years of cultivation. In the native species the berry is rough hairy or prickly, but in the cultivated varieties the berry is smooth or has but a few soft hairs. The fruit of the European varieties is usually larger than of the American. The bush is made up of stout upright branches, in the Eu-

ropean class and of slender gracefully curved branches in the American.

The European or so called English varieties in this country are very subject to the attack of mildew (*Sphaerotheca Morsuvae*), and this fact constantly turns the favor of Americans to the American varieties. The color of the fruit in European varieties includes red, yellow, green and white.

The names of some European varieties are Chautauqua, Columbus, Crown Bob, Industry, Triumph and Wellington Glory. These are considered the best among about 200 varieties tested at the Geneva Experiment Station in New York.

Varieties of the American species, *R. oxyacanthoides*, are Pale Red, Champion and probably Houghton, and varieties classed as American gooseberries, though hybrids, between *R. oxyacanthoides* and *Grossularia* are Downing, Pearl, Red Jacket and Smith.

Varieties of which *R. Cynosbati* seems to have been one of the parents with the European species, are Crystal and Mountain.

European gooseberries are very large, the fruit measuring an inch in diameter and over one and a half inches long, while the largest of our American varieties does not exceed three-fourths of an inch in diameter. The European varieties reach a marketable condition a few days earlier than the American varieties. European varieties are preferred when ripe to the American gooseberries by the preserving establishments and a higher price is paid for the former.

It remains to be said in favor of the American varieties that they are hardier, more resistant to mildew, more productive and have a better quality of fruit.

Propagation.

Gooseberries like currants are propagated by dividing the plants taking the young suckers or by mounding up the bush with earth to produce layers; this is the method known as "mound layering." The young canes produce roots freely in the earth and a larger number of plants may thus be taken in a year. Where even more plants are desired from a limited stock, as in a nursery, the general practice is to make hard wood cuttings. The mound layering method of propagation is best adapted to the European varieties because they do not root freely from cuttings, and the cutting method is applied to the American gooseberries. The cuttings are made of new wood when it is ripe in October, and cut in pieces six to eight inches long. These are tied in bundles of 25 or 50 and buried in a pile of earth or other well drained soil, until spring, when they are taken up and set in rows where they may root and form new top for one or two years. The cutting bed should be chosen with reference to its exposure and soil with the same care that one would use in selecting ground for a seed bed.

Soil and Preparation.

The soil for gooseberries is best it it is a moist, rich clayey loam. Sandy soils should be avoided, although with proper care this fruit has given satisfactory results in a variety of soils. Dry, sandy and gravelly soils do not bring out enough growth of bush to keep the plants in a thrifty condition. Gooseberries are usually planted as a secondary crop with other fruits and therefore we find them occupying ground, not to themselves, but in orchards or vineyards. Gooseberries succeed in shade much better than any other crop.

Land that has been under cultivation is in a fit condition for planting and requires no other preparation than plowing and harrowing. It is not best to make an application of barnyard manure when the soil is prepared for planting. This is best applied with the preceeding crop or after planting by mulching about the plants.

Planting.

Gooseberries should be set five feet apart in rows five feet apart, so that the cultivator may run both ways. If the planting is done in an orchard they should not stand nearer than six feet to the trees. In some plantations the cultivation is done in one direction only and then the plants are four feet by six feet apart.

The plants may need some pruning at time of planting. Bruised roots should be removed and long canes should be shortened, to develop new growth from the base of the young plant. The manipulation of the plants and the soil in properly setting gooseberries is not unlike that of strawberries or currants. The ground should not be too wet nor too dry at time of planting. Early spring planting is to be preferred because the young plants will "catch" much better in cool weather than in warm, but at such a time the ground is likely to be too wet, therefore, fall planting should be practiced in a soil that will not dry out quickly. With fall planting, a mulch around the plants, using loose manure, is excellent protection for the winter.

Cultivation.

In the early spring, the cultivator should be run through the plantation as early as possible, and the manure used to mulch the plants should be forked down about the young plants. Shallow cultivation should be kept up all the summer, to keep down the weeds and conserve the moisture in the ground.

Fertilizers.

(See under currants.)

Pruning.

The gooseberry calls for but little care in training or pruning, and yet it is important to bear in mind that new wood should be

formed annually to keep up a vigor in the bushes to insure an annual crop of berries. The English advocate training the plants in the form of trees. This is more easily accomplished with the European varieties than with American varieties, but it is not suited to our country at all. Plants in the tree form lose vitality rapidly after they are five or six years old and the crop of fruit diminishes also. With the low bush form it is always possible to prune out old wood that is losing vitality and encourage suckers of recent origin to develop wood for succeeding crops of fruit. Systematic pruning of gooseberries simply calls for the annual cutting out of old wood that has served its time of heavy bearing, and thinning out some of the new canes to prevent a too dense mass of brush. All canes or branches resting on the ground should be removed to aid in clean culture. Long canes are shortened so that they will stiffen up enough to hold their load of fruit above the ground. But little pruning will be required in the first and second years after planting. The thinning of canes is not for the purpose of letting sunlight into the interior of the bush; on the contrary it is better to have close head of foliage to shade the fruit for it often suffers greatly in strong sun light.

Harvesting and Marketing.

Gooseberries are marketed in the green or ripe stage. The American varieties are nearly always marketed green and are then used for stewing, making jam or canning. If a market will use the green fruit, it should be encouraged to do so, for if the berries must hang on the bushes to ripen there is much loss from sunscald. In Pennsylvania the gooseberries are always marketed in the quart berry baskets.

The picking of gooseberries is not a pleasant task, but one may become expert and rapid in this work by observing the nature of the plant. By catching the end of a drooping cane and raising it with one hand, the other hand may be used to gather the hanging berries from the whole length of the cane without much encountering the prickles. Pickers are usually paid two cent per quart.

Yield and Profit.

But few fruit growers have devoted much space to this fruit, and estimates of profit and yields are based upon small areas. If plants are in the open field, with good culture, and the plants set five by five feet, they will yield several tons of fruit per acre. Reports of actual yields from an acre of gooseberries range from two to four tons. Such yields run at about four and five thousand quarts which at five cents per quart would make from $200 to $250 per acre. Such excellent yields and good returns cannot be expected without the best cultural conditions and markets.

Varieties.

The relative merits of European and American varieties have already been discussed. The productiveness of the leading varieties is comparatively expressed in the following table of the average yields per bush for four years. The observations were made at the Geneva Experiment Station.*

European Class.	Average weight per bushel for 4 years, in pounds.	American Class.	Average weight per bushel for 4 years, in pounds.
Chautauqua,	1.99	Crystal,	13.13
Crown Bob,	2.88	Downing,	9.95
Golden Prolific,	2.13	Houghton,	6.85
Industry,	8.27	Mountain,	2.67
Puyallup,	5.08	Pale Red,	10.58
Triumph,	6.24	Pearl,	4.37
Wellington Glory,	8.35	Smith (Improved),	2.13
Whitesmith,	4.54		

Gooseberry-Currant is a novelty called *Crunells*. It is a hybrid between the two fruits named. The bush resembles a currant and the fruit a gooseberry. It forms an upright bush two to three feet high, and the fruit can be used like gooseberries. It has no commercial importance for the fruit grower.

Fungous Diseases.

Mildew.—The principal fungous disease of the gooseberry is mildew, *Sphaerotheca mors-uvae*. It has a special liking for the European varieties, to such a degree that few fruit growers will plant the foreign varieties. Mildew attacks our American varieties if warm moist weather prevails during June and July, or if plants stand in soil not properly drained. The disease first appears on the young shoots and leaves and later it attacks the green fruit, giving it a dirty, brown color. Fruit thus attacked is unmerchantable and the plants suffer from the injury to the foliage.

The cobwebby material of this fungus is a network of mycelium formed over the surface of the plant. In many fungous diseases the mycelium grows within the tissue of the plant and cannot be touched with fungicides. In this case, however, a remedy of this kind becomes effectual.

Treatment.—Sulphide of potassium is the remedy to be applied for this mildew. Use one ounce of the sulphide in two gallons of water and spray the plants as soon as the buds are unfolding. The

*Bul. 114, N. Y. Exp. Sta., Geneva.

treatment should be repeated several times at intervals of a week or ten days until the fruit is harvested. Though the mildew may develop later the injury is slight and spraying is unprofitable.

Leaf-spot.—See under currant.

Insects.

Currant worms.—See under currants.

Borer.—See under currant.

Fruit Worm.—A small worm is often discovered eating the substance of the fruit of gooseberries and sometimes of currants, leaving only the skin. The loss by them is not very great as a rule. The adult is a moth, *Dakruma convolutella*, which lays a single egg upon the green berry. The larvae soon hatching from the egg bores its way into the interior of the fruit, when the contents have been devoured it passes to another fruit after tying the two together with silken threads. It may thus continue its feeding until five or six fruits have been destroyed. When fully grown the larva drops into the rubbish under the bush there pupates and remains until spring.

Treatment.—Hand picking of the first injured fruits answers in every case, as the number of "worms" is usually small and the injured fruits may be easily destroyed.

Currant Leaf Hopper.—See under currant.

The José Scale.—See under currant.

CRANBERRY.

Cranberries are grown in bogs and, therefore, their culture is confined to particular areas where swamp land exists. The States that lead in the cultivation of this fruit are Massachusetts, New Jersey and Wisconsin. These three States produced in 1899, over 96 per cent. of the entire crop of the United States. The total area devoted to this crop that year was 20,434 acres; the product was 987,516 bushels, valued at $1,215,059. The average yield per acre in Massachusetts is 115 bushels, but in New Jersey and Wisconsin the average yield was considerable less, partly because of a failure in the crop for the year the statistics were gathered. No cranberries have been grown in Pennsylvania, although there is a limited area of bog land that could be utilized for this crop with some profit. Two great sources of loss are frosts and blight, therefore, the grower seeks such conditions in which he may more or less control these difficulties.

A successful bog is one in which it is possible to drain the surface water to at least one foot below the surface of the ground in the summer. The bog should be level to permit of flooding the entire surface in times of frosts. A sufficient water supply is also nec-

essary to accomplish this. Cranberries suffer greatly in times of drought. The natural bogs usually have peaty or muck soils and are more or less covered with sphagnum. Several kinds of bog plants, shrubs and trees may be growing over such areas. All such growth is removed by "turfing," that is, digging out the plants and roots, or the bog may first be flooded and kept under water for a season, thus killing much of the growth by "drowning."

There is considerable expense and labor connected with the preparation of a bog, therefore, only men of means are tempted to engage in cranberry culture.

Open ditches two to four feet deep are run through the bog to carry off the water when necessary. These ditches carry the water through a common gate which can be closed to flood the bog from December to April, and for brief periods at other times to destroy insects or protect from frosts.

Cranberries assumed commericial importance about the middle of the nineteenth century, when several thousand bushels were being marketed annually, principally in Boston. The bogs first receiving attention were those at Cape Cod, Mass., which are to-day in the greatest cranberry centre of the world.

Preparation for Planting.—After "turfing," as already stated, the surface soil is cut into small squares and removed. Clean, coarse sand is then hauled upon the surface to a depth of about four inches. The plants are then set in this sand. The sand furnishes uniform conditions and keeps down weeds. Every four or five years an additional inch of sand is spread over the surface.

Cranberries have been planted in rich alluvial soils and made magnificent growth in them, but such vigor of vine is always a cause of no fruit. Sand is therefore to be chosen, because the plants do not become rampant and their yield of fruit is normal. In Wisconsin the plants are set in the peaty bottoms without the use of sand.

Propagation.

Formerly cranberry meadows, as they are called, were planted by using "sods" cut from a native growth of cranberries, but now propagation is universally by cuttings. The strongest young runners are cut into pieces about eight inches long and planted directly where they are to fruit, instead of passing a period in a nursery bed as most young plants are handled. The cuttings may be planted with a sharp stick, inserting them obliquely, leaving but two or three inches of the tip to project. Sometimes longer vines in pairs are dropped on the surface of the ground about a foot apart and tramped into the soil. Another method is to cut the vines in a hay cutter, scatter the short pieces broadcast over the surface and rolled them in.

The planting is done in April or May, whatever method be employed. Fall planting may be done successfully, but it is seldom practiced.

Care of Meadows.—After the plants or cuttings are set out it is desirable to have the surface matted over with new growth as quickly as possible to insure an early and abundant crop of fruit. To encourage such growth the meadow must be kept thoroughly drained as already stated, keeping the water at least a foot below the surface. In about three years the growth should make a good mat and then yield a fair crop of fruit. During the early years of a meadow the weeds must be kept out; a hoe may be used in the first year, but later the weeding must be done by hand.

When there is a drought the meadow may be flooded about once a week. When fruiting, vines must be flooded to protect against frost, the water must be withdrawn early in the morning to avoid scalding the fruit.

Harvesting.—Cranberries are harvested with a "scoop rake," or by hand. The former method is harsh in the treatment of the vines but it is cheaper than by hand. The hand method is recommended above the raking method. The fruit is shipped to the markets in barrels or bushel boxes. The cost of picking by hand is about 50 cents per bushel. One barrel is a day's picking for a good hand. The present prices for this fruit ranges from four to six dollars per barrel. The yield of fruit ranges from 50 to 200 barrels per acre, making a probable income of $200 to $1,200 per acre annually. The cost of preparing and planting a bog is estimated at about $350 per acre.

The cranberry is closely related to the huckleberry, being properly, certain species of *Vaccinium*. We have two species growing in North America known as the small cranberry, *V. Oxycoccus*, and the large cranberry, *V. Macrocarpon*. They are found only in swamps and are small trailing perennial plants. They are often largely concealed by a dense growth of sphagum.

Varieties.—The large cranberry is the species now receiving so much attention in cultivation and quite a number of varieties have already been named and catalogued. Three general types are observed in the shape of the berry, namely, the bell-shape, the bugle-shape and the cherry-shape. Berries of the different shapes vary in size from one-fourth to one inch in diameter, and are generally a bright crimson or carmine color when fully ripe. The large and well colored fruit is preferred.

The bell-shaped varieties are: Early Black, Early Red, Franklin, Gould and Lewis. The bugle type is represented by Dennis and MacFarlin, and the cherry type by Makepeace.

The flavors of the several varieties is about the same, and while

the large berries sell best, the medium sized berries are more firm and solid, and may be kept longer.

HIGH-BUSH CRANBERRY OR CRANBERRY TREE.

This fruit is in no way related to the swamp cranberries. It grows upon a deciduous shrub which makes a bush eight to twelve feet high. Botanically, it is a *Viburum*, *V. Opulus*, indigenous to North America, and perfectly hardy in this latitude. The bush resembles the old fashioned snowball bush familiar in most country homes. In fact, the two plants are the same species, the snowball having sterile showy flowers and, therefore, producing no fruit, the highbush cranberry having small flowers and producing large clusters of red fruits, somewhat smaller than swamp cranberries, but have a cranberry-like acidity that makes them useful for pies, tarts, etc. The fruit further differs from the true cranberry in having a single stone instead of many small seeds.

The highbush cranberry is easily propagated from seed cuttings or layers and will thrive anywhere in the berry garden. The fruit is ripe in October and hangs on the bush until destroyed by freezing. The fruit has some value, but has not yet become popular.

HUCKLEBERRY.

The huckleberry is more especially a native crop, but it is likely to receive increased attention from the fruit grower because of the popularity it has gained in the markets, the fine quality of the fruit and the hardships attending the gathering of the berries in mountain lands. Large quantities of blueberries are gathered annually in the eastern States through which the Appalachian mountains extend, especially in New England. Several years ago, it was estimated that 20,000 bushels were shipped annually over the Boston and Maine Railroad. In the southeastern part of Maine, a region 150,000 acres in extent, is known as the blueberry barrens. The owners collect a royalty of one-half cent per quart for all fruit harvested by sundry pickers. The bulk of the crop is shipped to canning factories, but the early fruit is usually sent to the cities for immediate consumption. In 1900 there were seven canning factories engaged in canning blue berries in Maine, the largest one having a capacity of 700 bushels per day, and an average annual output of 8,300 cases of two dozen cans each, worth $1.90 per case.

Under the common name of huckleberries, will be considered all the fruits that pass in various States as huckleberries, whortleberries, blueberries and bilberries. When properly used, these names refer to the blue or black fruits of several native species of *Vaccinium*. The most important of these are *V. Corymbosum*, *V. Pennsylvanicum*, *V. Canadense*, *V. Caespitosum* and *V. Vacillans*.

1. V. Corymbosum is the highbnsh blueberry or swamp huckleberry. It is the "huckleberry" of the Pennsylvania mountains and

westward. The plant is a tall straggling shrub, four to twelve feet high in moist woods or swamps. The berries are blue-black with considerable bloom and excellent flavor. It is exceedingly variable and has several distinct forms in nature. This fact makes it a fit subject for improvement. The plants may be easily transplanted and succeed in a good garden soil. It has been planted for ornament, but should be cultivated for its fruit.

2. V. Pennsylvanicum is the low blueberry of the sand barrens, dry hills and woods in Pennsylvania. The plant is a dwarf shrub six to fifteen inches high with slender branches, on which are borne sweet bluish black berries with a bloom. These are the first "huckleberries" to ripen, being picked for use and the markets early in July in this State. The low bushes are usually laden with fruit which is easily picked. Most of the early blueberries in the city markets are furnished by this species. Among the mountain pickers these are known as the "early sweet" or "low sweet" huckleberries. White fruited varieties of this and the preceding variety have been found, but they will no doubt always occupy the position of a novelty as do the white blackberry and white strawberry.

3 V. Canadense is the Canada blueberry, a shrub one to two feet high with an erect habit and crowded branchlets. The berries are globose or oblate, blue with much bloom and an excellent flavor. This species is found in the mountains of Pennsylvania and northward. The leaves being downy on both sides occasioned the name of velvet leaf among pickers. The fruit is not so sweet as in the preceeding species, and is not as early in ripening.

4. V. Caespitosum. Dwarf bilberry. This is a very low tufted shrub two to twelve inches high with shining smooth leaves, berries solitary, large, blue, with bloom, sweet. This species does not occur in Pennsylvania, but is a valuable one in the cold regions north of latitude 45 degrees.

5. V. Vacillans. This species bears the common names of low blueberry and blue huckleberry and is found in dry sandy places, particularly west of the Allegheny mountains. This one may be distinguished from *V. Pennsylvanicum* in its more erect habit. The berries are large, blue with much bloom, and an excellent flavor. The fruit ripens with *V. Canadense.*

The species of *Vaccinium* having fruits without a bloom or with hairy skin are all inferior to those described and hence will not attract the cultivator. Two species of *Gaylussacias* have edible fruits known as huckleberries, but are inferior to Vaccinium species described.

Propagation.

The blueberries are not easily propagated by the simple method employed with other fruits. Plants may be transplanted from

their native situations to afford them better treatment than they have had, and a plant having special value could be propagated by grafting upon common stocks. The method, however, by which extensive propagation is done is with seed. This work is best performed by the nurseryman who has the facilities and skill necessary to secure good results. The seed should be washed clean of the pulp of the ripened fruit and sown at once in flat boxes or seed pans. Perfect drainage is insured by an inch of potsherds in the bottom of the seed pans. This is covered with a layer of sphagnum to prevent the soil being washed into the drainage. The soil is prepared by mixing one-third each of rich loam fibrous peat and clean sand, finely sifted and pressed firmly in the seed flats. The seed is sown thickly over the surface and covered with a thin sprinkling of soil. After covering with a layer of sphagnum the flats are placed in a cold frame and watered. After the arrival of cold weather, about the first of January, the flats are brought into the greenhouse and careful attention given to keep the surface moist. After a few weeks the seedings will appear and the sphagnum cover is removed. When one or two true leaves have been made the seedings are picked out into other flats prepared as for the seed, and kept shaded from hot sunshine. On the approach of winter the flats containing the plants are put in a cold frame and when the leaves have dropped the frames are covered with straw or litter for the winter. The following spring the young plants are set in beds of prepared peaty loam, four to six inches apart and cared for as such plants usually require with water and shading for another season. Two-year old plants may be planted where they are intended to fruit.

If seed has been dried before sowing it will seldom germinate until the second year.

Blueberries will fruit in four or five years from the seed.

Cultivation.

For twenty-five or thirty years attempts have been made to bring blueberries into cultivation, but because of some difficulties connected with the experiments and the abundance of the native fruit little progress has made. The blueberries prefer a sandy loam, and depend largely upon humus for their best growth. The cooler situations and exposures should be given them and such treatment as is usually given to other bush fruits is all that is required. Prof. W. M. Munson* writes: "The ordinary fruit grower may, however, secure a stock of plants from a neighboring pasture or swamp, and by giving the same attention to culture which he would give to currants may secure very satisfactory results. For this purpose, the highbush blueberry, *V. corymbosum* and its varie-

*Bul, 76, Maine Exp. Sta., 1901.

ties are perhaps the best sorts. They are relatively easy to transplant, either from swamp or upland, and are of good size and very prolific. The variety *amoenum* is a rather dwarf form with very large berries and grows freely on the upland. *V. vacillans* is the next best species for cultivation as a small fruit."

There are hundreds of acres of waste land in Pennsylvania where perhaps the huckleberries are growing in scattered patches that could without much expense be put into condition and planted and prove a profitable investment for the owner.

Harvesting.

Huckleberries and blueberries are commonly picked by hand, taking only ripe fruit. In New England, use is made of a device for picking the crop in the latter part of the season, and more especially upon areas that are intended to be burned over the next year. The young growth after a burning is always more productive for several years than older bushes, and the picking devices known as the "blueberry rake" is destructive to the plants, hence the discrimination in its use. The implement looks like a dust-pan in which the bottom of the pan is made of stiff parallel wire rods and is similar to the cranberry rake. The fruit is gathered quickly and cheaply with the rake, but many leaves are picked with the fruit. The fruit is then put through a fanning mill to remove the leaves.

Pickers receive one an one-half to three cents per quart for their work, and the fruit sells in the markets at from 5 to 10 cents per quart.